Tappi

PUBLISHED BY THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY

JUNE 1954

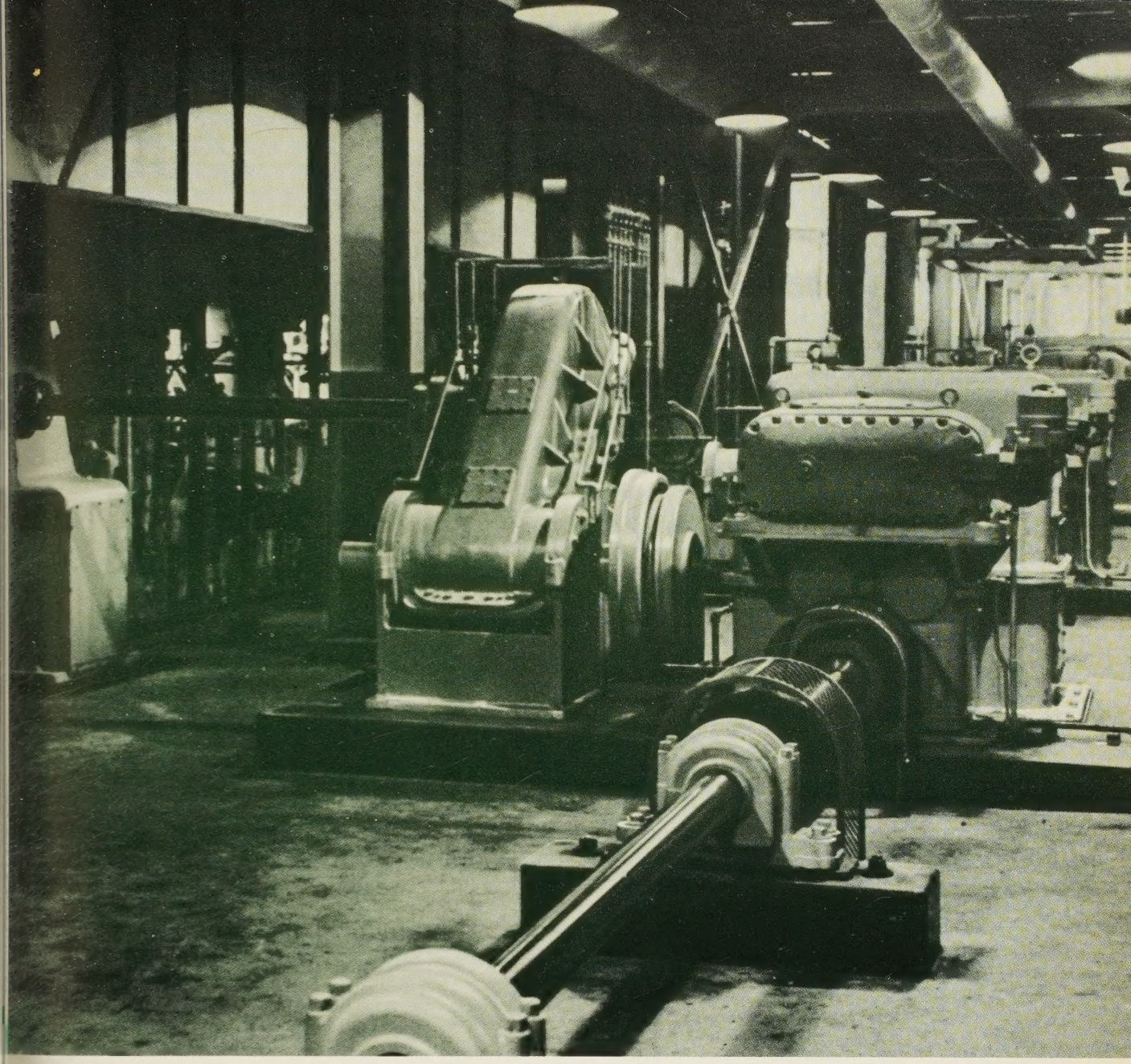
VOLUME · 37 NUMBER 6

talking ?

If you are interested in talking about way and means of cutting hidden costs and uppin product quality, let's talk about the improve line of Cities Service Pacemaker Waxes. Ca or write Cities Service Wax Dept., Sixty Wa Tower, New York 5, New York.

CITIES SERVICE

QUALITY PETROLEUM PRODUCT



BELOIT DIFFERENTIAL DRIVE holds steady draws mechanically. No belts to slip or motors to vary under changing power demands. Gears are of standard types, for simplified maintenance. Extremely exact adjustment of draws makes possible minimum strain on the sheet, thus reducing shrinkage in width, raising sheet tests, and sharply cutting machine breaks.—*Beloit Iron Works, Beloit, Wis.*

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Du Pont Dyes

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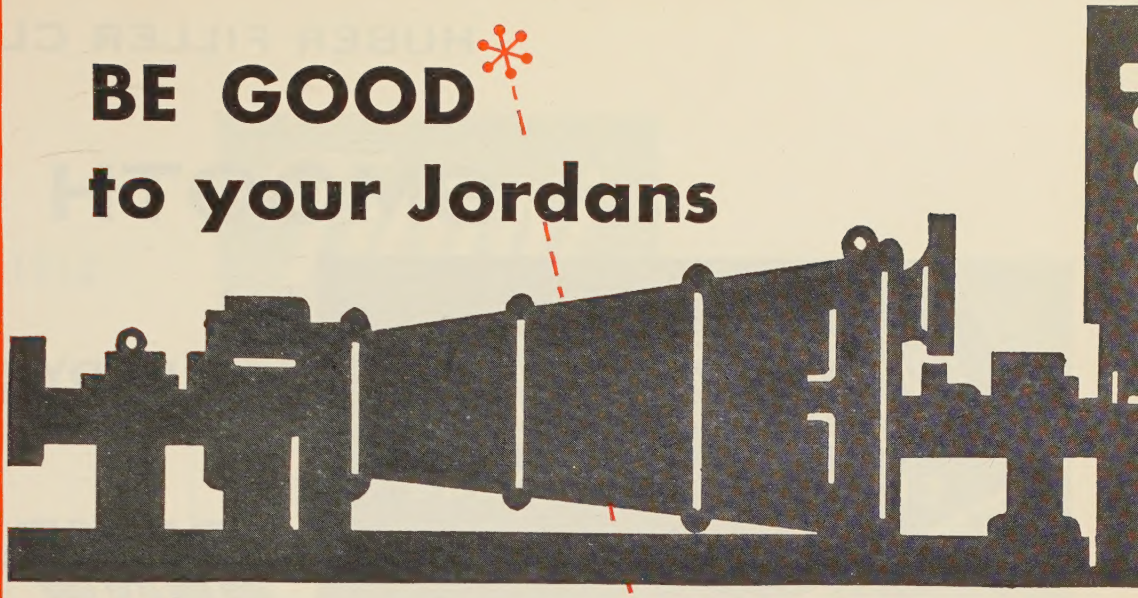
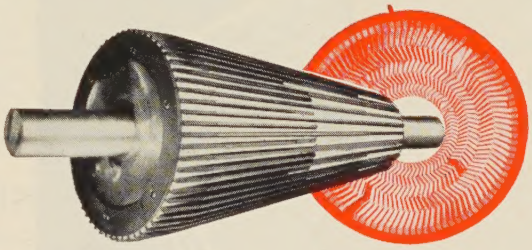


and they will be good to you



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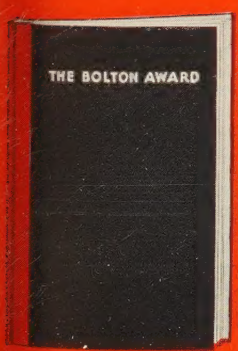

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JUNE 1954

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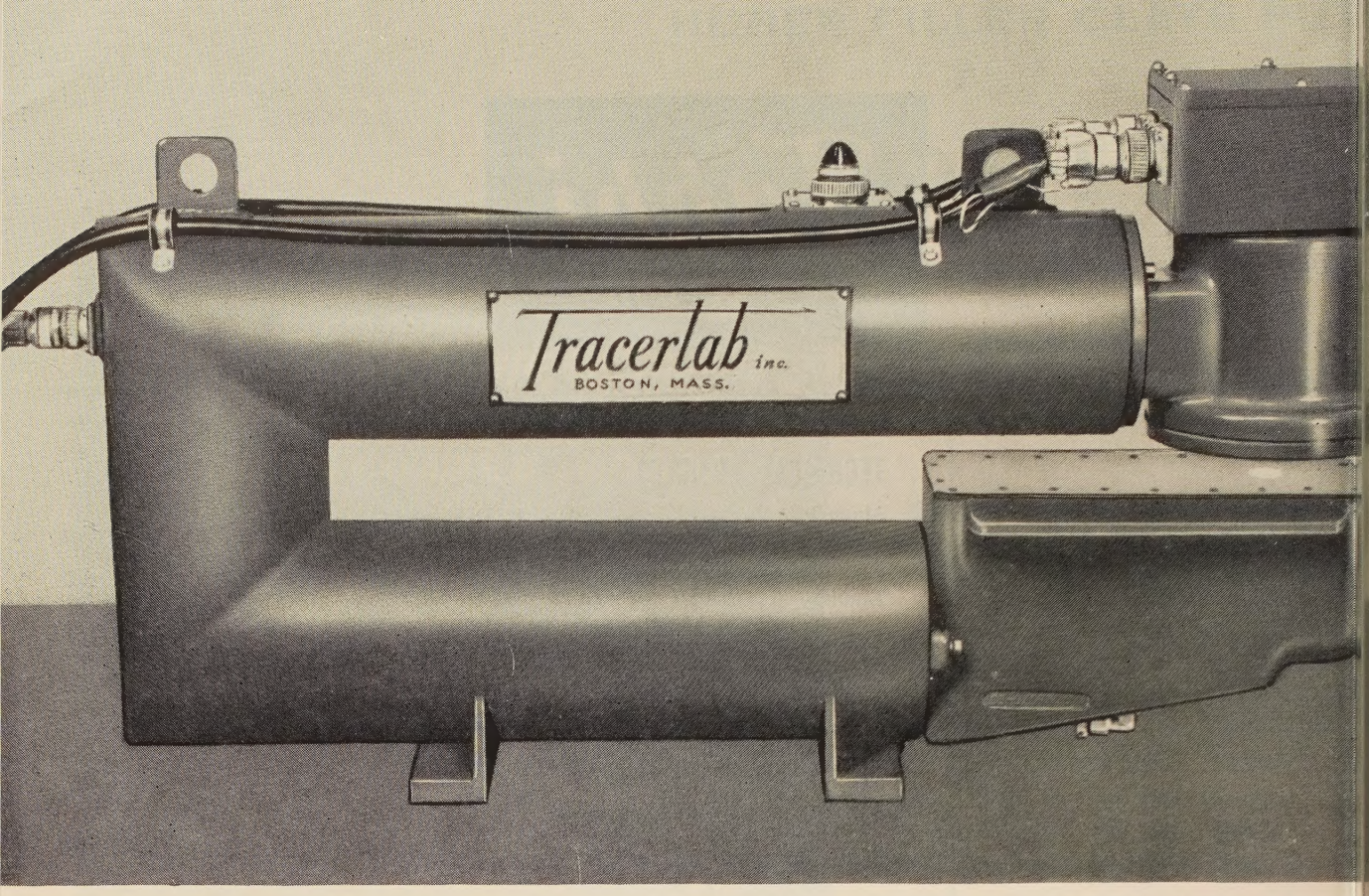

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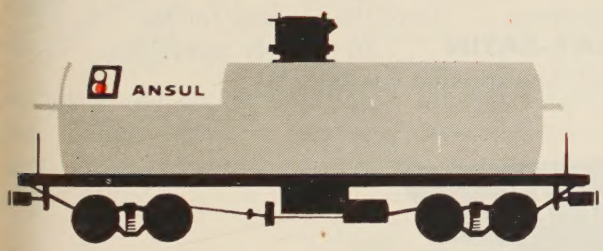

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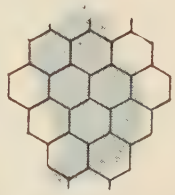

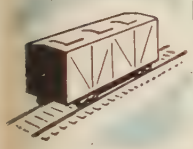

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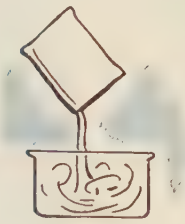

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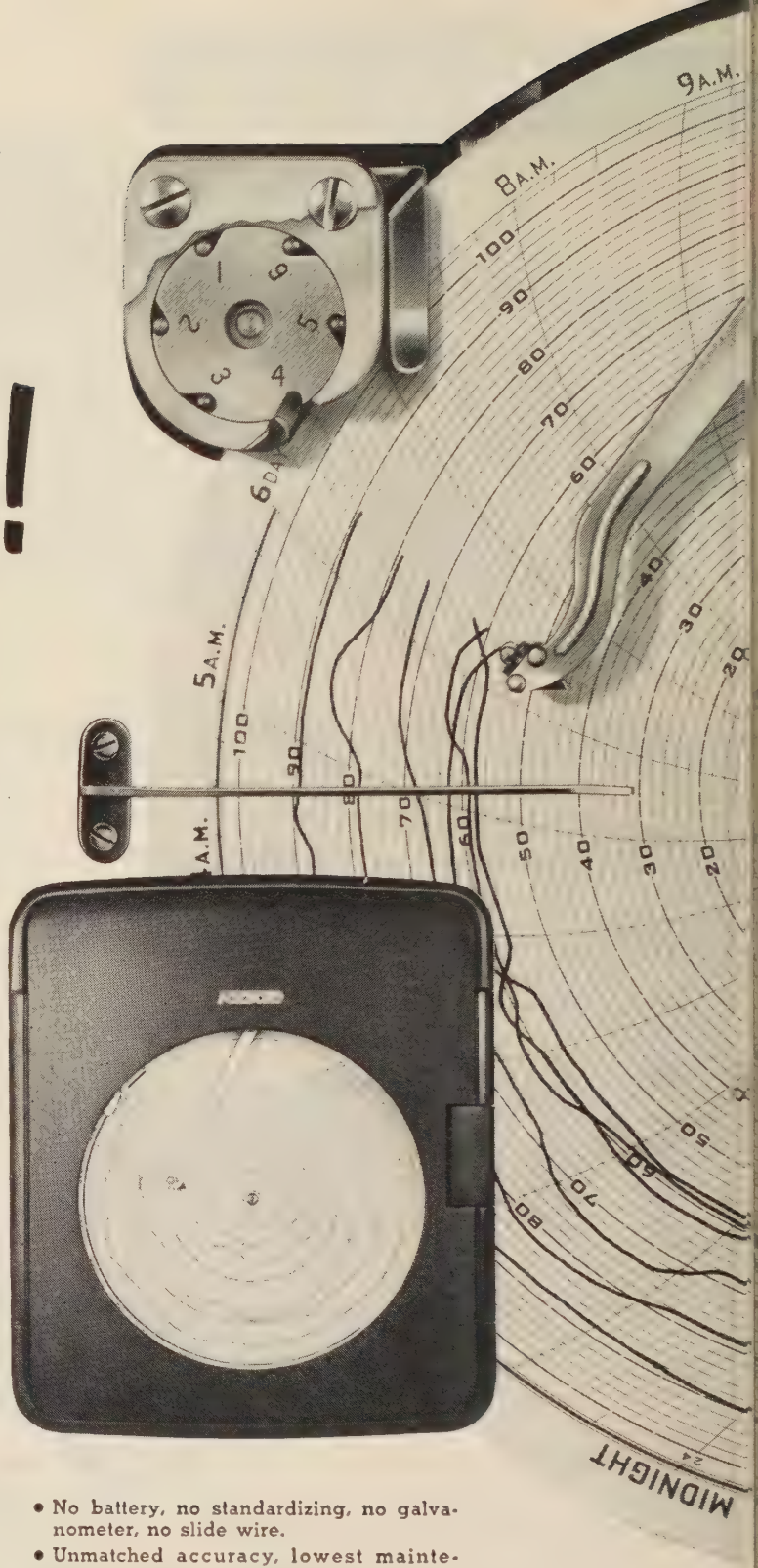

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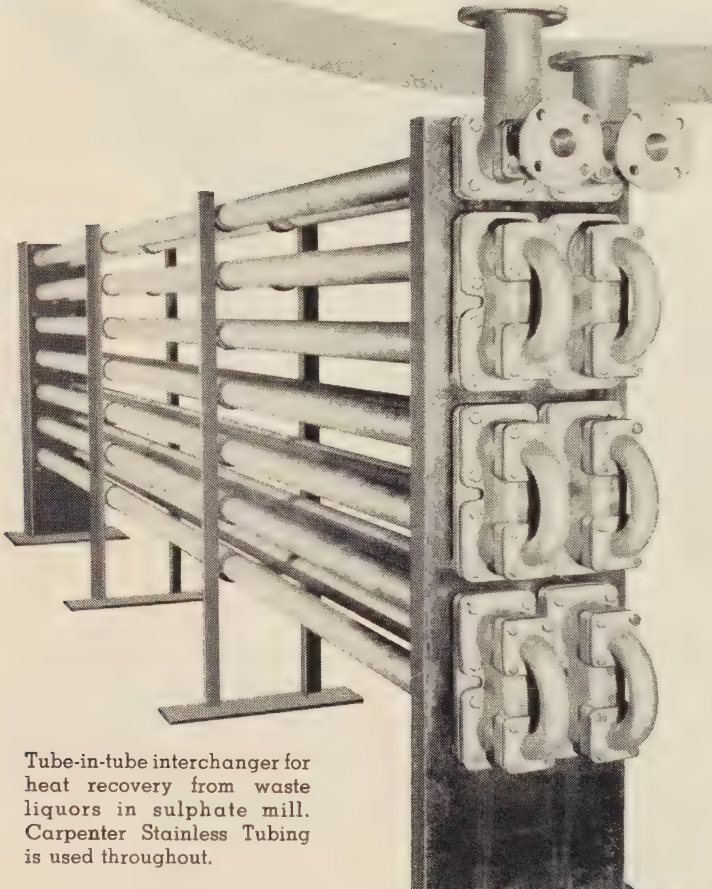

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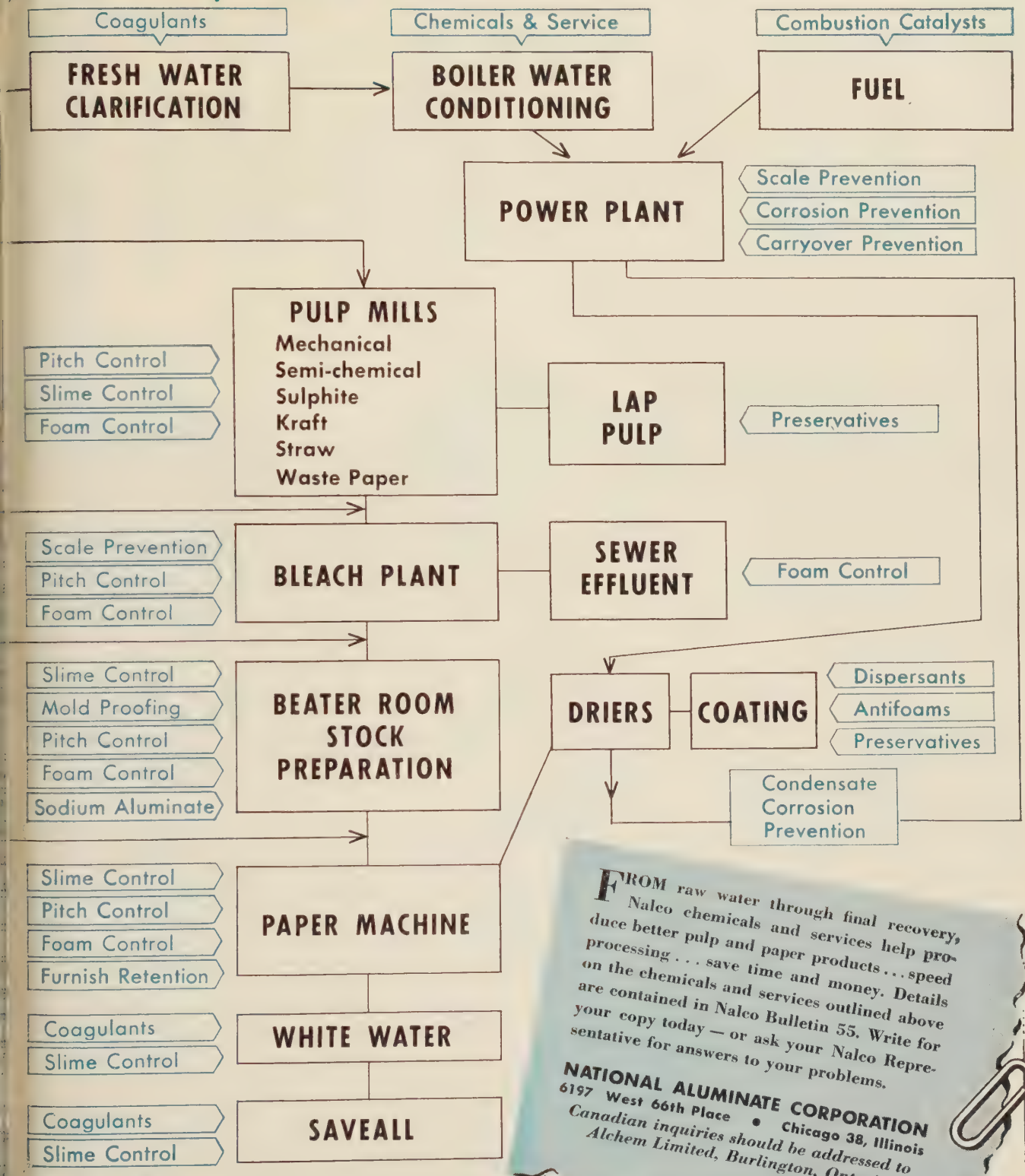

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JOHN S. TURNER and J. NEWELL STEPHENSON

THE first 25 years of "Fifty Years with the Canadian Pulp and Paper Industry" were Published in the May issue of *Tappi*. Because of the length of this article, which was prepared by John S. Turner and J. Newell Stephenson on the 50th Anniversary of *Pulp and Paper Magazine of Canada*, it was divided into two parts. The following section is devoted to the period 1928–1952. Again, acknowledgement is made to the authors and the Canadian journal for the permission to reprint the article in *Tappi*.

1928

L. R. Wilson, president of the CPPA wrote a lengthy report on the industry in 1927. In it he noted that newsprint production had increased faster than the demand for it and that pulp prices had eased off, due to a slackening of demand from south of the border and to stiff foreign competition. Fifteen new paper machines were started in 1927, with a daily capacity of 1600 tons, 11 of which were in the province of Quebec, where three new mills opened. These were Canadian International Paper Co., at Gatineau, Ste. Anne Paper Co. Ltd., at Beaupre, and Anglo-Canadian Pulp & Paper Mills Ltd. at Quebec. One new mill was established in Ontario, that of the Thunder Bay Paper Co. at Port Arthur. Four other large mills were expected to be in production during 1928.

Financial finagling continued to occupy the top spot as far as newsworthiness was concerned, with a marked tendency noted for security houses to purchase going concerns, leaving the management in the main unchanged but revamping the stock setup, so that invariably somehow there was stock left over that had to be sold. Nesbitt, Thomson, for example, acquired the Bathurst interests, a company which had newly entered the news field and was producing 130 tons daily. Royal Securities bought the Rolland Paper Co., leaving the Rolland family in charge but issuing new stock. St. Maurice Valley Corp. joined with the perrennial money-maker, the Laurentide Co., to form Canada Power & Paper Corp. In looking over their assets after the deal was completed, they discovered that they owned a mill which, while it did produce a small quantity of newsprint was better suited to specialty lines. This was the Canada Paper Co. which they sold to the Howard Smith organization. Howard Smith and Harold Crabtree had just teamed up to buy Lincoln Pulp & Paper Co., followed by their acquisition of Ritchie & Ramsey Ltd. of Toronto, paper dealers and paper coaters. They also bought the Georgetown Coated Paper Co. and combined the last two into Alliance Paper Mills Ltd. When Spanish River was finally absorbed by Abitibi, Col. C. H. L. Jones, who had meanwhile been elected the new president of the CPPA, resigned and became manager of the new paper mill being built at Liverpool, N. S., which was eventually known as Mersey Paper Co. N. E. Wainwright of Provincial Paper Ltd. bought the old Don Valley paper mills, and Price Brothers absorbed Donnacona. International Power & Paper Co. of Newfoundland Ltd., was formed, a Canadian International Paper subsidiary, to take over the assets of Newfoundland Power & Paper Co. at Corner Brook. South of the border Crown Zellerbach was formed, which included the Canadian subsidiary, Pacific Mills Ltd. at Ocean Falls, B. C. The Dryden Co. receivership was lifted, and new capital was obtained t open the mills at Port Mellon, B. C.

Only one major fire was noted during the year, that v destroyed the Hastings Paper Mills Ltd. at Belleville, O $100,000 plant of which O. A. Porritt was owner-mar Western Quebec Paper Mills at St. Andrews East, the s Canada's first paper mill, went into liquidation. Death o I. H. Weldon, president of Provincial Paper Ltd. and o the founders and second president of the CPPA, and G H. Millen, president of the E. B. Eddy Co., at the a 90.

Outstanding Mill Improvements

Dominion Engineering passed through a significant They obtained the order for the two new 160-in. paper chines for the St. Lawrence Paper Co. at Three Rivers, foll by a call for the two machines for New Brunswick Int tional Paper Co. at Dalhousie, N. B., each 234 in. wide. company also took over control of Charles Walmsley (Can Ltd., which was installing Minton driers and other specia equipment as well as paper machines and winders.

Spruce Falls Power & Paper mill at Kapuskasing, jo owned by Kimberley-Clark and the *New York Times*, opened, with four 234-in. machines. The Summer me of the Technical Section was held in the head-of-the- district, and one part of the trip was made on the ill- S. S. *Noronic*. Canadian Paperboard Co. opened its To boxboard mill, the largest in the world at that time w daily production of 125 tons. Hinde & Dauch purchased erty adjacent to its Toronto factory and began the e of a five-story office and plant.

From an editorial standpoint publicity first appeared i Pulp and Paper Directory to be issued by the Industr Educational Press. Lagerloef Trading Co., on the occas its 10th anniversary, used color in its advertisement.

1929

In his presidential address at the annual meeting o Royal Bank of Canada, Sir Herbert Holt referred to th balance of trade between Canada and the United States. former country not only sold the latter $790 million ag imports of some $500 million, but our exports were essen newsprint and raw materials that fed their factories as pared with our imports of manufactured goods to the ment of our own industries. He also stressed the nee developing trade in the Pacific.

An interesting article related the experiment of waxin wrapping paper for shipping lettuce from California. first order for 500 lb. became a 5 million lb. business years.

A statement in the annual report of Pacific Mills Ltd that a sinking fund of $2.00 for each 1000 ft. of timber l is maintained.

The "Broke Hustler" which had been published as a w at Iroquois Falls since 1917 was changed to a monthly n zine and issued from the Toronto office of Abitibi Pow Paper Co. "Abitibi" ranks among the best publications class.

S. F. Tillman, of the U. S. Division of Simplified Pra wrote on the great savings by simplification of various

JOHN S. TURNER, Assistant Editor, and J. NEWELL STEPHENSON, Editor in Chief, *Pulp and Paper Magazine of Canada*, Gardenvale, Que.

Merfenel 51*

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of paper and paper products. He mentioned some effects of standardization of forms by government offices.

An accident that caused deep regret to many friends happened to John T. O'Reilly at Cap de la Madeleine. He slipped while crossing the switch tracks at the mill and was run over by a shunted freight car, losing his left arm and right leg. He later went to California, had a car specially equipped and became a successful insurance salesman.

The American Newspaper Publishers' Association advised members that the International Paper Co. was offering 5-year contracts for newsprint, f.o.b. mill with freight allowed to destination. Prices varied according to customer's location, from $61.50 to $64.

A serious fire at the Lybster plant of Alliance Paper Mills on February 27 destroyed the third and fourth floors and the roof together with stock and supplies. Prompt and effective work by the fire departments, with friendly help from neighboring mills had the fire under control in about 3 hours. The paper machine was not damaged and operations were soon resumed.

Business Still Improving

Annual statements for most mills showed that business conditions were on the upgrade and profits improved somewhat over the previous year.

An event of considerable interest was the formation of Mid-West Paper Sales Ltd., which purchased the business of Provincial Paper Sales Ltd. Branches were established at Winnipeg, Edmonton, and Calgary for the wholesale trade.

A. E. Cadman contributed an article on the world newsprint supply. Latest figures showed Canada well in the lead with a production of 2,381,102 tons (2000 lb.). Then in order came United States 1,414,953; Great Britain, 620,000; Germany, 580,000; Sweden, 240,000; Japan, 240,000; Newfoundland, 230,745; Finland, 210,000; Norway, 190,000; France, 120,000; Austria, 55,000; Belgium, 50,000; Czechoslovakia, 45,000; Mexico, 14,000. Canada exported 2,206,587 tons in 1928.

The Canadian International Paper Co. enlarged its Kipawa rayon cellulose capacity from 75,000 to 100,000 tons a year. Bathurst Power & Paper Co. announced the installation of a second newsprint machine. About 20 years later Bat discontinued newsprint production in favor of its growi terest in container board and container manufacture.

Vancouver Kraft Co. at Port Mellon, B. C., subsidia Columbia River Paper Co., began a $1,500,000 develop program with the construction of a deep-sea wharf.

In the United States a large producer of kraft pape nounced an increase in price from $75 to $85 a ton.

The Restigouche Co. began construction in March $4,000,000 sulphite mill at Athol, near Campbellton, N.

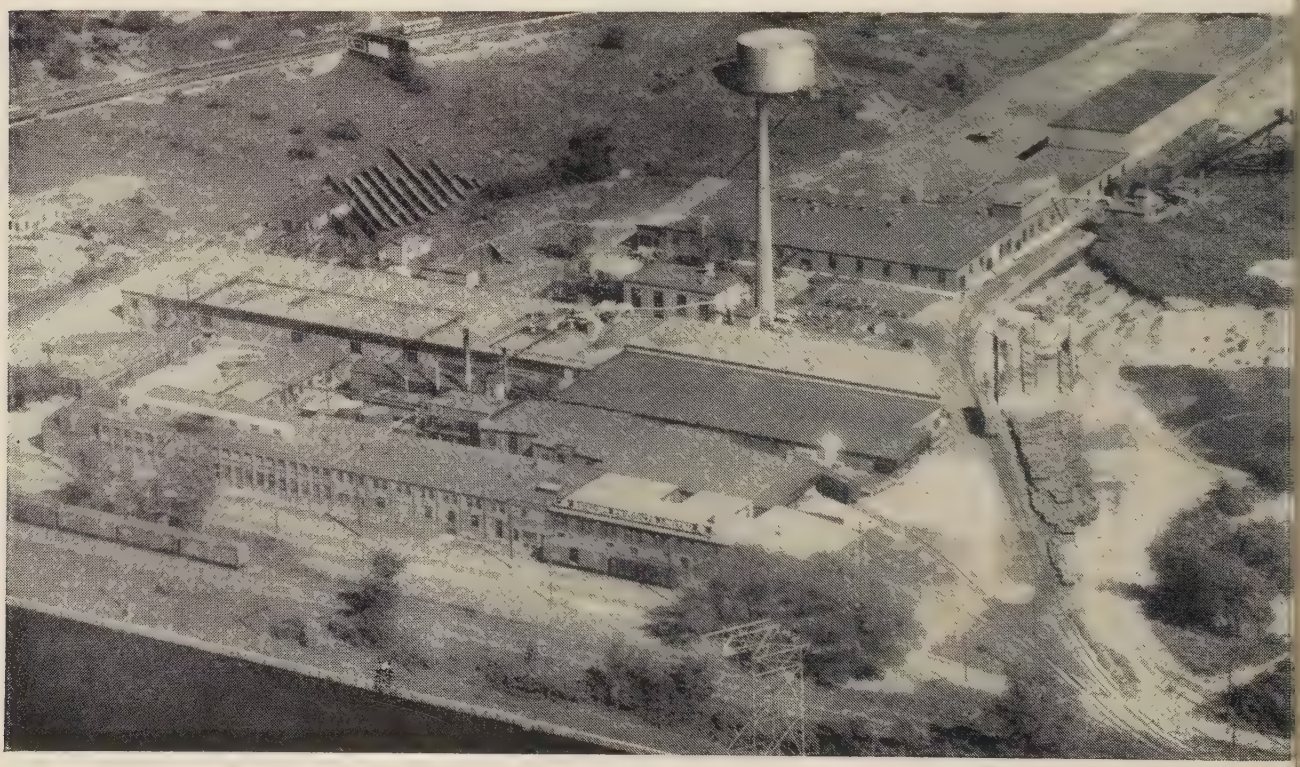
Arthur L. Dawe, a former secretary of the Canadian and Paper Association, established a gold medal to be k as the "I. H. Weldon Medal" for competition among me of the Technical Section. The late I. H. Weldon, preside Provincial Paper Ltd., and president of the Canadian and Paper Association had been keenly interested in th tivities of the Technical Section and well deserved this morial award, which has been personally presented t winner nearly every year by the donor.

New Publisher of Pulp & Paper Magazine of Canada

Another milestone was set up in April, 1929, when ow ship of *Pulp and Paper Magazine of Canada* passed from Industrial & Educational Publishing Co. Ltd. to Nat Business Publications Ltd. The latter included A. S. Ch who had been advertising manager since 1915, J. N. Ste son who had been editor since 1917, Miss E. C. Knox who been accountant since 1913, Capt. F. W. Wallace, edit *Canadian Fisherman*, R. C. Rowe, editor of *Canadian M Journal*, and W. H. Hewitt, manager of the Toronto o J. J. Harpell, who had been publisher of this magazine 1912, was president of Garden City Press where printing c paper remained and where the head office of National Bus Publications remains.

What was then the world's biggest paper machine—30 wide—was started up on April 5 by the Great Lakes Pu Paper Co. at Fort William, Ont.

An article by A. D. Little on the value of laboratory ex ments and pilot plant tests had the significant title: "N Small Scale Blunders and Large Scale Profits."



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The British Wood Pulp Association, gathered for their annual banquet, were astonished to hear that an order had been signed for £12,500,000 worth of newsprint. This amazing contract had been given by William Harrison, chairman of the Inveresk Paper Co. of London to Edward Lloyd Ltd. for 25 years' supply of newsprint for newspapers controlled by Mr. Harrison's company. Mr. Harrison was a "safeguarder" of the British paper industry and fighting champion of tariffs on imports, although it was anticipated that, if a duty were levied on newsprint, the rate would be reduced on Canadian paper. A. Ralph Reed, president of the British Paper Makers' Association, put in a word for standardization of pulp quality and spoke of the activity of the British Technical Section in this field.

A rather unusual transaction was the sale of the Thunder Bay Paper Co. to Abitibi Power & Paper Co. and Canada Power & Paper Corp. The former owners were Consolidated Water Power & Paper Co. of Wisconsin who had operated a groundwood pulp mill there since 1922. C. D. Howe was active in establishing the enterprise, and F. N. Youngman was first manager of the paper mill.

An equitable distribution of newsprint orders was a much-chewed bone of contention. The validity of long-time contracts was found a serious obstacle to readjustments.

The death of Frank McGovern caused deep regret in the industry where he was a familiar and honored representative of F. C. Huyck & Sons. His wide knowledge of papermakers' felts was highly respected.

J. L. A. Macdonald, technical adviser of the famous Tullis Russell Paper Mills of Scotland, visited Canada. His old friend, Gus Hellstrom, gave a luncheon in his honor, at which leaders of paper research were present.

S. F. Duncan was elected president of Provincial Pa Ltd., succeeding the late I. H. Weldon with whom he had b associated for about 20 years.

The first of the year saw good progress being made on new mill of Mersey Paper Co. at Liverpool, N. S., and on extension for two more machines at St. Lawrence Paper M Co. at Three Rivers.

On the resignation of S. J. Frame as secretary of the nadian Paper Box Manufacturers' Association, C. B. Hod was appointed to the post.

A group of three Russian papermakers visited mills Canada and the United States and said they wanted to st methods of utilizing lumber mill waste. They said Ru had some 98 mills in operation. Most equipment was Germ One mill had a 234-in. Bagley & Sewall machine.

An article by Douglas McMurtie in our issue of January published for the first time the terms of the first Ameri paper trade agreement. It was adopted by a conference papermakers in Boston on April 15 and 16, 1795. A scal prices was agreed for a period of 3 months and subsequ meetings were held. This historic affair is retold in issue.

Early in the year, a decrease in demand for newsp caused a considerable cut in production. Some mills clos others operated intermittently or at reduced capacity. equitable distribution proved a difficult problem.

Pulp and Paper Institute Opened

Following the annual meeting of the Canadian Pulp Paper Association, at which Col. C. H. L. Jones, O.B.E., re-elected president, the Pulp and Paper Research Instit was officially inaugurated. The new building at 3420 U

Pulp and Paper Research Institute on the McGill campus in Montreal

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versity St., Montreal, had been erected and equipped by co-operation of the Canadian government, McGill University, and the Canadian Pulp and Paper Association. The industry's share was financed through sale of bonds, in which this magazine participated. The University allocated land for the project.

Promptly at noon His Excellency, Viscount Willingdon, Governor General of Canada, arrived and was escorted to the hall of the Institute by Col. Bovey of McGill. Col. Jones presided and introduced His Excellency, who expressed regret that illness kept Sir Arthur Currie, principal of the University, at home, and declared that his own motto while Governor-General would be "cooperation," which was so well exemplified in this great enterprise. Other speakers were Hon. Charles Stewart, Federal Minister of the Interior, and C. F. Martin, acting-principal of McGill University. In introducing Dean Martin, Col. Jones, mentioned the generous bequest of Mrs. E. B. Eddy for the establishment of the Department of Cellulose and Industrial Chemistry at McGill. Then followed an inspection of the building and Lord Willingdon officially inaugurated the Research Institute by starting machinery in the model pulp and paper mill. Following the opening ceremony the annual luncheon was held, at which the speaker was Ira A. MacKay, dean of the Faculty of Arts, McGill University. At the President's Dinner, the premiers of Nova Scotia and New Brunswick were present and the premiers of Quebec and Ontario were represented.

The Technical and Woodlands Sections had excellent programs. The former elected R. A. McInnis as chairman, and the latter elected R. H. Nisbet. A feature of the Technical Section luncheon was the presentation to George Carruthers whose leadership was largely responsible for the publication of the textbook, of a set bound in red Morocco of the five volumes of the "Manufacture of Pulp and Paper."

A newsprint Service Bureau chart showed that production of newsprint in the United States and Canada increased from 569,000 in 1899 to 3,796,000 tons in 1928. The average annual rise for the 30-yr. period was 6.8%.

The statement was made by a director of the B. C. Power Corp. that the Crown-Williamette Lumber Co. has the water power rights on the Campbell River, presumably for the object of supplying power for a paper mill "which they might establish in that vicinity." Sequel: the Elk Falls Co. Ltd. at Duncan Bay is now operating with power developed by the B. C. Power Commission on the Campbell River.

A banquet was given by citizens of Hull, Que., to welcome Victor M. Drury, new president of the E. B. Eddy Co.

The Canadian Pulp and Paper Association inaugurated a campaign for the wider use of Canadian made paper by Canadians. A similar campaign was carried on by printers and lithographers. The idea was well received and many firms in the habit of simply ordering "same as before," became aware of the quality and variety of the Canadian product.

Two 1-week courses in sulphite pulping were given at the U. S. Forest Products Laboratory. Men from several Canadian mills attended and were well pleased with the work done. The capacity was overenrolled, as only 15 could be accommodated in each course.

H. H. Horsfall succeeded Mr. Wallberg as president of Lake St. John Power & Paper Co. He was also president of the newly formed Canada Wire & Cable Co.

Considerable interest was shown in various quarters over the announcement that International owned stock in some 13 American newspapers. The general attitude among Canadian newsprint men was that the matter was entirely I.P.'s business and refrained from further comment.

A series of articles in this magazine described the facilities, personnel, and program of the Pulp and Paper Research Institute.

Hinde & Dauch Paper Co. completed a $1,500,000 extension to their plant at Toronto. A new building was erected to house a 150-ton board machine and auxiliary equipment.

The feature article in the May 16 issue described t
Lawrence Paper Mills plant at Three Rivers. With tw
machines installed, the daily capacity was increased
tons of newsprint. The Canadian International Pape
on the other side of this city had recently established a
of 729 tons in 24 hours.

Bagley & Sewall made a 234-in. paper machine f
Volga River Pulp & Paper Co. Three erecters went c
set up the machine and three operators were to go la
show the Russians how to run it.

Luncheon Honors S. J. B. Rolland

A very happy affair was the luncheon given by a n
gathering of friends in the paper industry to Stanislas
Baptiste Rolland on his 78th birthday. Col. C. H. L.
president of Canadian Pulp and Paper Association, wa
ter of ceremonies and, with the assistance of Secretary
presented Mr. Rolland with a handsome souvenir of the
sion and of affectionate respect of his confreres.

Considerable interest was shown and some concern w
regarding the treatment that pulp and paper might get
new United States tariff. The new bill placed "sta
newsprint paper" on the free list.

An aftermath of the War Measures Act of 1914 a
rulings of the Paper Controller in 1918 was the case c
Frances Pulp & Paper Co. Ltd. versus Spanish River P
Paper Co. Ltd. The former claimed a right to paym
the latter for the differential in price of newsprint Fort F
was required to supply Canadian publishers. Judge
failed to find any foundation for the claim.

Following the publication of the second edition of
Manufacture of Pulp and Paper" the Joint Textbook
mittee established an Advisory Committee on Revisio
the 74 men and one woman (Helen Kiely) 22 have b
terested in the fourth edition, now practically finished.

The new two-machine mill of Lake St. John Pow
Paper Co. was described in the June 28 issue c
magazine.

The Technical Section held a very successful Summ
ing at Kent House, Que., and at the Ste. Anne Pape
Beaupre. Papers were read by John S. Bates on "The F
Status of the Research Institute." Harold Hibbert on "
tific Research in the Manufacture of Pulp and Paper
"Practical Research at the Institute" by E. Parke-Ca

Through exchange of shares, Howard Smith Paper
assumed technical ownership of the mills and other pr
of Canada Paper Co.

A successful innovation was the holding of the Woo
Section Summer meeting in Northern New York an
England, a round trip of about 1100 miles in which I
carried the 40 foresters and operators. First stop w
pulpwood operations of Finch, Pruyn & Co. at New
N. Y., where a day and a half were spent. The part
motored to Saratoga Springs and inspected the forest n
of the New York State Forest Conservation Commiss
drive across the State of Vermont brought the cavalc
Lincoln, N. H., where a trip was made by logging railro
very interesting mixed-stand operation. At Berlin, N.
seed extraction and testing plant, show room, mills, and
tories of Brown Co. were visited and an inspection was
of the Jericho demonstration forest. Next day, thes
made a motor-boat trip over the Rangely Lakes to the
ings logging camp where Marinus Westveld gave a t
"Growing a Full Crop of Pulpwood." The flotilla con
to the Casuptic forest nursery of Brown Co. and the pa
turned to Canada via Rumford, Me., where they were
of the Union Bag & Paper Co. at luncheon.

Announcement was made in September by Nationa
ness Publications that a magazine devoted to woods
tions, silviculture, etc., would be published monthly.

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scribed in our issue of September 26. It was the 305-in. newsprint machine at Great Lakes Paper Co.

Consolidation of Port Alfred Pulp & Paper Corp. and Wayagamack Pulp & Paper Co. with Consolidated Power & Paper Corp. was announced in September. This gave Consolidated Power & Paper Corp. a total paper production of 2438 tons daily. Of this newsprint made about 1900 tons.

As one of the contributors to the Research Institute Building fund, the publishers of *Pulp and Paper Magazine of Canada* were pleased to learn that the project was completed with a balance in the bank of $7520.23. Secretary Beck's statement showed that a total of $420,656.31 was received; $308,693.26 was spent on building and equipment; $100,000 was paid to McGill University as an endowment fund for upkeep, etc.; $3533.82 was spent for legal expenses, etc.; $908.70 for alterations. The balance of $7520.23 was transferred to the general fund of the Canadian Pulp and Paper Association.

The Edmundston Pulp and Paper School opened its second session of evening classes with H. J. Atkinson as instructor-in-chief.

Paper Mill Improvements

After considerable opposition from rival interests, Powell River Co. was awarded the right to develop the power on the Lois River. This site would provide a total of 30,000 hp. but only one 15,000-hp. unit was to be installed in the first stage. Powell objective was an ultimate daily production of 1000 tons of newsprint. (This has been reached.)

Price Brothers & Co. installed two 100-ton machines in 1929 at Riverbend, the second coming into production in November.

A development program by Spruce Falls Power & Paper Co. extending over 2 years converted a 100-ton sulphite mill into an enterprise producing 550 tons of newsprint a day, with an excess of high-grade sulphite. In addition to the pulp and paper mills at Kapuskasing, the company built a 75,000-hp. hydroelectric plant at Smoky Falls.

A "Produced in Canada" exhibit was held in Montreal in November, at which 250 concerns displayed their products. Disappointment was expressed that there was so little material to represent the pulp and paper industry.

Three paper companies moved into their new home at 388 University Ave., Toronto, where the new building of Provincial Paper Co. was opened. The other two occupants were Interlake Tissue Mills Co. and Don Valley Paper Co. The new Abitibi building next door was nearing completion.

The editor presented a paper, "What Research Has Done in Paper Making and Using," at the International Conference of Technical Experts in the Printing Industry at Pittsburgh, Pa.

Throughout the year, F. J. D. Barnjum persistently pressed his plea for forest conservation. Differing from Barnjum's campaign to restrict export of pulpwood, A. Joly de Lotbiniere, in a forceful article, advocated the practice of forest management that would harvest merchantable trees in a manner that would not damage the remainder but encourage new growth of more and better timber.

Announcement was made of the newly established Institute of Paper Chemistry, associated with Lawrence College at Appleton, Wis. This new graduate school was headed by Ernst Mahler, vice-president of Kimberly-Clark Co. and supported by a number of pulp and paper firms. Otto Kress was appointed technical director.

Formal opening of the Mersey Paper Co. took place Brooklyn, N. S., mill at 12:20 p.m. on December 14, w Hon. E. N. Rhodes, pressed the golden button. Col. C Jones, O.B.E., president of the company, presided camp-type luncheon. Addresses were made by Rhodes, William Duff, M.P., and Hon. W. L. Hall.

International Paper Co. announced that their p newsprint would remain for 6 months at $55.20 per to

1930

Editorial comment about the year 1930 was definit favorable, with no one shedding a tear for its depart though it is easy enough for us to look back and say don't know how lucky you were—the worst is yet to Everyone seemed to be optimistic at year's end, an op untinged by a "whistling in a graveyard" undercurrent able in 1933. The Grim Reaper did remove a nur prominent pulp and paper people from this mortal coil, ing D. F. Brooks, founder of the Powell River Co., and Curtis, president of The Ontario Paper Co. Percy B. director of the Newsprint Institute of Canada, died, other severe blow to one of the industry's service organi was the demise of Edward Beck, manager of the Other paper industrialists to pass on were J. F. Booth A. Bothwell of the Brompton organization.

Harold Crabtree, although he did not realize it at th got a lion by the tail by being elected president of the C job he retained for the 4 depression years of 1930 t 1933. C. R. Whitehead of Wayagamack became gener ager of the newly formed Canada Power & Paper which followed a somewhat stormy course until it eme Consolidated Paper Corp. Provincial Paper Ltd. was with the Abitibi group through Dominion Securities projected merger was the formation of St. Lawrence which was actually consummated only a few years ago would have united St. Lawrence Paper Mills Ltd., L John Power & Paper Co. Ltd., at Dolbeau, Que., and ton Pulp & Paper Co. Ltd., to form an entity with $68, in assets and an annual production capacity of 283,0 A merger to end all mergers was proposed, to co Abitibi, Canada Power & Paper (which already ha Canadian on the hook), the new St. Lawrence C Backus Brooks interests, and possibly Price Brothe Newfoundland government turned thumbs down Hearst proposal to build a large pulp and paper mill a der, to be supplied by wood from Labrador. Colon Price resigned as president of the Newsprint Institute

New Brunswick International Paper Co. mill at Dalhousie

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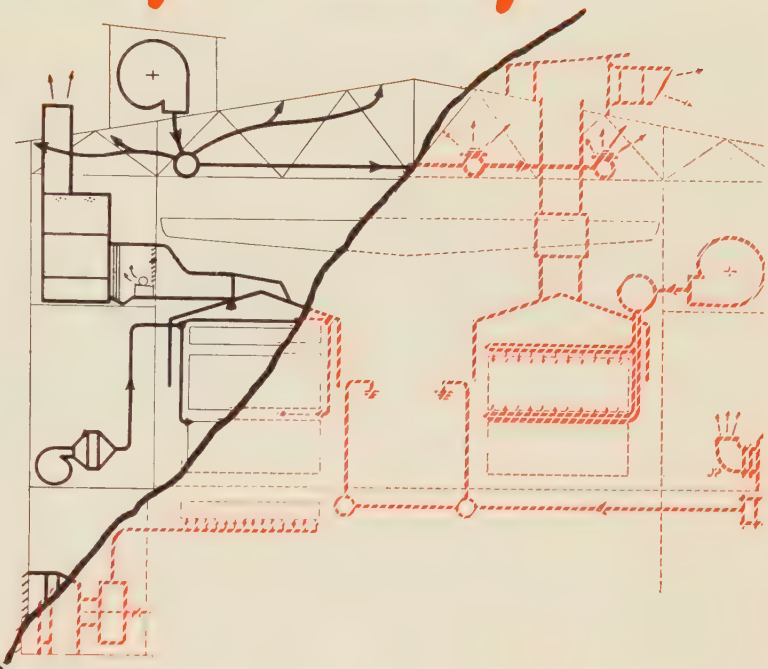

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ROSS ENGINEERING OF CANADA, LIMITED, MONTREAL, CANADA • CARRIER-ROSS ENGINEERING COMPANY, LIMITED, LONDON, ENGLAND

ada, claiming that the marketing agreement made by members of the organization was being openly flaunted in advertisements by one of the parties to it, and Price Brothers entered suit against the other members for a dissolution and an accounting for funds subscribed to run the organization, to which Price Brothers had contributed heavily. The first Pulp and Paper Engineering Catalogue made its appearance, the predecessor of today's Pulp and Paper Manual of Canada.

Men and Machines

Personalities mentioned during the course of the year 1930 included Douglas B. Chant's appointment as manager of the Sturgeon Falls division of Abitibi. J. H. Black resigned as general manager of Spruce Falls Power & Paper mill at Kapuskasing, which was under the control of the *New York Times*, to become assistant to the president of Abitibi. At Spruce Falls he was succeeded by E. S. Noble. Major Edward Flynn moved up from manager of the Jonquiere and Kenogami mills of Price Brothers to assistant to the president. H. W. Cressy, now manager at the James Maclaren Co. Ltd., went from the St. Lawrence mill at Three Rivers to the head office in Montreal.

Pre-1929 momentum carried over into 1930 with the opening of the New Brunswick International Paper Co. at Dalhousie, N. B., where there were four machines running before the end of the year, the last two being rated to run at 1235 f.p.m. bringing the daily production figure up to 550 tons. Fraser Companies Ltd. opened their Athol, N. B., plant, a bleached sulphite pulp mill, and Hinde & Dauch opened its board mill in Toronto. The James Maclaren Co. started up their two news machines in the lower mill at Masson, Que., a project first mentioned in the first number of this publication 27 years before. On the West Coast Powell River com one of its several modernization and expansion program one to the tune of $8,000,000, and the Westminster Pap reopened after a severe fire.

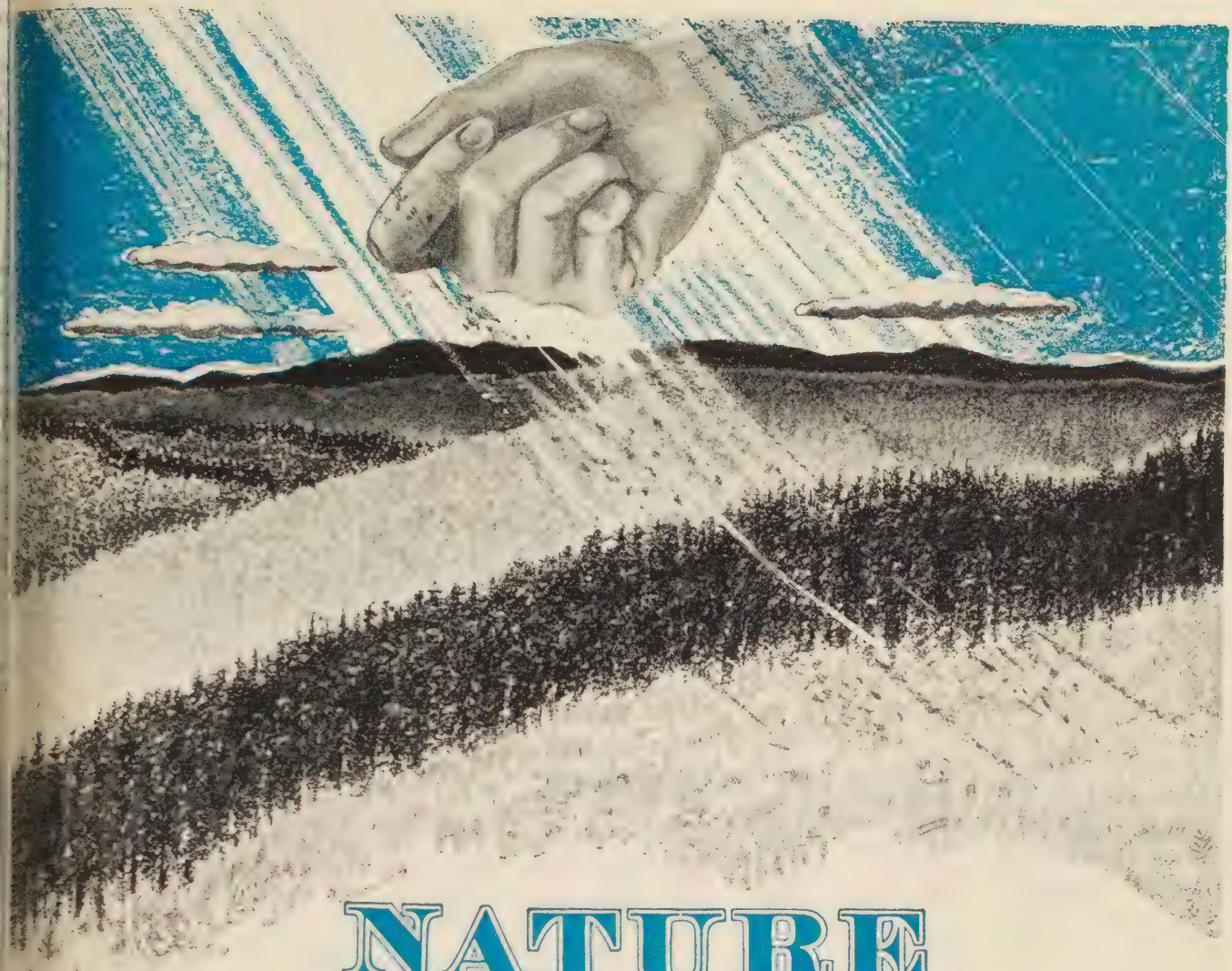
To end this depression year on an appropriately s note, closings during the year included the Nashwaak P Paper Co. at Fairville, N. B., a subsidiary of the Oxford Co. in Maine; the Chicoutimi Pulp Mills, and the Sau Marie division of Abitibi. The Canadian Paperboar Ltd. went into receivership.

1931

Looking backwards to 1930, there are two contrasti ures of interest. During the year there were seven new machines put into operation, including the seventh Powell River, making a total tonnage of 875 daily. T face of the production rate of 69.3% of rated capacity lished during the year. Naturally, paper machine planned for well in advance, and trying to cancel an orc one is much the same as the man who decided to take plunge in the morning and changed his mind halfway be the diving board and the water. Newsprint producti mained at a pretty high level, however, standing at 2,2 tons for the year as against 2,504,147 for 1930. At the 1931 production had dropped to 58.4% of capacity, a gross value of all industry products had dropped 11.6% 1930. The newsprint price was $53 a ton delivered i York or Chicago.

It may or may not be a point, but when business was the industry seemed to lose only a few good men each ye to death, but during the depression many more seemed called to the final accounting. As in 1930, the pulp and

Great Lakes Paper Co. Ltd.



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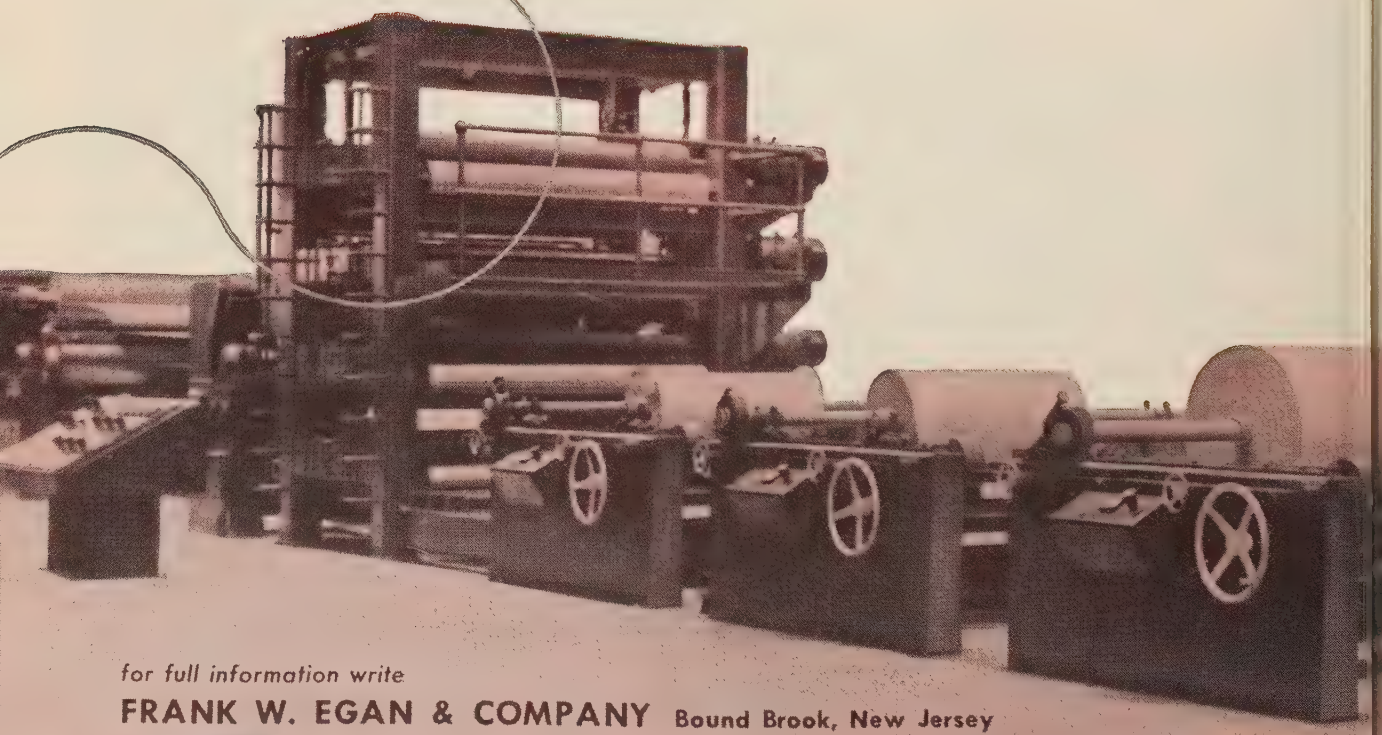

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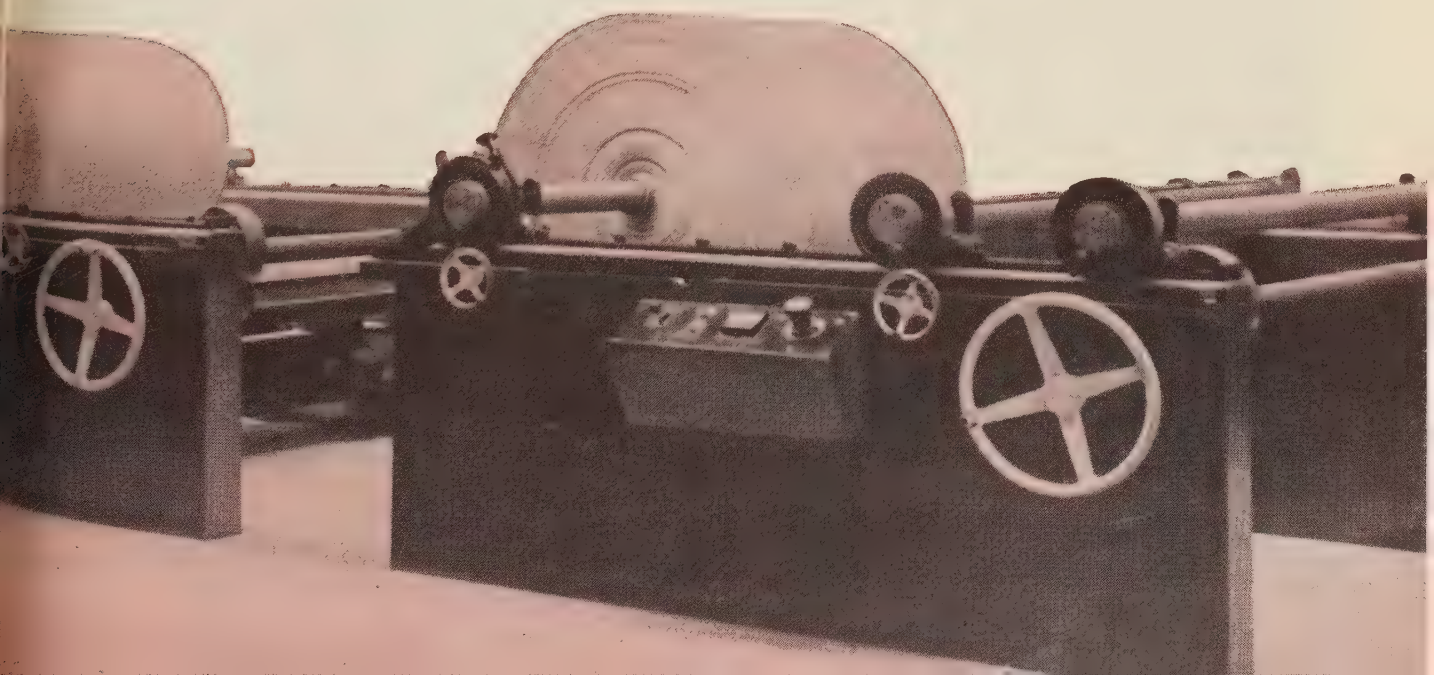

service organizations were hit hard by two demises, those of E. P. Cameron, director of the pulp and paper division of the Forest Products Laboratories, and O. F. Bryant, secretary of the Technical Section, CPPA. The latter died from a heart attack which hit him while in his office. Prior to his position with the CPPA, he had been manager of the Nashwaak Pulp & Paper Co. in New Brunswick until it was forced to close due to general business conditions. P. T. Dodge, a rare combination of inventor and executive, also died. He was the chief developer of the Mergenthaler linotype machine, and his improvements were just what were needed to make the machine a practical and marketable piece of equipment. At the time of his death at 80 years of age he had over 100 inventions to his credit. As far as the pulp and paper industry is concerned, he was president and chairman of the board of the International Paper Co. and its subsidiaries. Three men died who gave their names to their pulp and paper enterprises—C. Howard Smith, Charles Riordon, and Joseph Ford. Angus McLean, founder of the Bathurst Co. and president of the Canadian Chamber of Commerce, also passed away. Other deaths in the industry included three men at Powell River who were killed by a collapsing scaffold due to a flaw in a hook and six at Lancey, France, when a digester exploded.

Some degree of consternation was caused in the mill that first installed magazine grinders when one of these monster machines suddenly stopped. A girl being shown through the mill pressed one of the pretty buttons!

Men and Miscellany

Personalities in the 1931 news were Harold Crabtree, who succeeded C. Howard Smith as president of Howard Smith Paper Mills Ltd., Frank Silver, who went from Price Brothers for a temporary stint across the line at the new pulp and paper plant at Bucksport, Me., and Carl Jentz, who went from the Cap de la Madeleine mill of Canada Power & Paper Corp. to the St. Lawrence mills on the other side of town. J. D. Gilmour was chairman of the Woodlands Section, CPPA, woods manager of Anglo-Canadian Pulp and Paper Mills Ltd., and host to the Summer meeting of the Section on Anglo's Montmorency limits. At this meeting there were several portable power saws demonstrated. The best seemed to be a German one called a "Stihl," with a one-cylinder two-cycle mo veloping 8 hp. It took 7.5 sec. to cut through a 10-in. log, weighing 85 lb., and required two men to oper Parenthetically it might be remarked that Gerard Lav through a log of the same size by hand in 6.1 sec. at t Woodlands Section meeting.

Safety commanded more attention as all leaks in fi dams were plugged as well as possible. With reduced and shorter hours, accident victims were prone to m and prolong their disability periods, and the Ontario P Paper Makers Safety Association put on a drive again practice. In Quebec the Quebec Pulp and Paper Safety ciation planned to incorporate, with Louis Armstr Canada Power and Paper as president. W. L. Ben Brown Corp. was secretary of the first meeting.

About the only financial move of great importance w succession of Canada Power & Paper Corp. by Conso Paper Corp. Ltd., but with Anglo-Canadian politely out of the new organization.

New devices, all with money-saving possibilities, w orange-peel type grab for pulpwood recovery offered Thew-Lorain crane people, roller bearings for pulp gr and the application of the photo-electric cell as a paper indicator, smoke controller or to other uses. Russia be loom as a menace, as some peeled pulpwood made its a ance on the Canadian scene. An Order in Council pla embargo on the import of goods produced in Soviet with the implication that the labor used to produce tha largely forced and unpaid.

1932

The issue for March, 1932, marked an important ste was taken in the publication of *Pulp and Paper Maga Canada*. It was changed from a weekly to a monthly p cal and the page size increased to $9^1/_4$ by $12^1/_4$ in., heavier sheet, giving the paper a much finer appearanc change enabled the publication in one issue of the articles that had to be broken because of space limita the weekly issues. Commenting on the change, Harol tree, president of the Canadian Pulp and Paper Ass said:

St. Lawrence Paper mills at Three Rivers, Que.

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Better Printing With Aniline Ink on milk bottle cap laminated to aluminum foil is credited to Sodium Phospho Aluminate. ½% of Sodium Phospho Aluminate added to the tray water to pH 6.0 is the procedure at a Midwest mill. The mill reports that previous printing difficulties due to acidity of the paper have been practically eliminated.

* * *

A Rise In Butyl Carbitol Test from 35" with water to 60" with CYRON* Synthetic Size was achieved at an Eastern mill. The size was dissolved according to instructions, neutralized to pH of 7.0 with caustic. A defoamer was added and the CYRON applied at a 1% concentration to the surface of a white patent coated sheet from one water box on the calender stack, giving the significant improvement in test results.

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More Uniform Machine Coating with AZITE® 900 Liquefier is reported by one Southern mill, using 10% AZITE based on casein adhesive.

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"Wishing you every success."

In the March issue there began a new feature which still continues to be appreciated by readers. Under the title "Prominent Men in the Industry" a brief biographical note was given of Alfred Erwin McMaster, director and general manager of the Powell River Co.

The young man, W. Gordon Young, who wrote the interesting story of how Joseph Ford came to Canada as a stowaway in 1850 and established the firm of Joseph Ford & Co. is now a director and secretary of National Business Publications and advertising manager of *Pulp and Paper Magazine of Canada.*

In the March issue was also an article on the organization, mills and other properties of Consolidated Paper Corp. Technical articles included "The Effect of Variables in the Soda Process" and "Research Essential to Prosperity of Industry."

The Abitibi Power & Paper Co. was the subject of a feature article in the April issue. An account of the Imperial (economic) Conference reviewed the Empire's tariffs on paper (continued in May issue); B. A. Malkin described the electric steam generator and its advantages to pulp and paper mills.

G. F. Towers, now head of the Bank of Canada, wrote in May on foreign exchange—its effect on the pulp and paper industry.

The Port Alfred Div. of the Canadian Power & Pulp Corp. suffered the most serious fire loss in Canada's history. The destruction of some 200,000 cords of pulpwood delayed resumption of production after a long shutdown. The mill had been readied for an immediate startup.

CIP Expands, Price Bros. Reorganizes

With the acquisition of New Brunswick International Paper Co., the Canadian International Paper Co. became the world's largest producer of newsprint paper. Capacity of the CIP group at Dalhousie, N. B., Three Rivers, and Gatineau, Que., and Corner Brook, Nfld., was then over 2800 tons per day. Without Corner Brook (now Bowater's) the CIP daily capacity is now 2660 tons.

Reorganization plan for Price Brothers & Co., subject to appro[val] security holders, was outlined [at] general meeting of shareholders o[n] 4. Lord Beaverbrook was the l[ead]ing figure in the matter. Of the di[rec]tors elected at that meeting, Allan A. [Mc]Lean and Sir Keith Price are still [on] the Board, but none of the officers [of] today are now in office.

The Canadian Pulp and Paper [Ass]ociation submitted a brief to the g[ov]ernment of Canada on the position [of] the industry in regard to Empire [trade]. This was supplemented by a co[m]prehensive article on the facilities and production of Canadian mills interes[ted] in export trade.

St. Catharines, Ont., was the lo[cale] for the Summer meeting of the Tec[hnical] Section. Over a hundred membe[rs] guests were present at the luncheon, when John W. [Hill], production manager of the Chicago *Tribune* spoke on "[Color] Printing in the Newspaper." On behalf of donor, Art[hur] Dawe, George Carruthers presented the I. H. Weldo[n] morial Award to Otto Brauns. The great concentrat[ion] mills in the Niagara district provided many interesting [visits] —Alliance, Interlake, Provincial, Ontario Paper, [E. B.] Wood Fibre. Visits were also made to the Foster W[heeler] plant, Niagara Wire Weaving Co., and the Interna[tional] Paper Co. at North Tonawanda and Niagara Falls, N. [Y.]

Our August issue commented on "the suddenness [with] which the treaty for the development of the St. Lawren[ce] way was completed." Barnjum's comment was a [fair] comparison of government cutting protection of forest[s] needed for insurance of Canada's most valuable raw m[aterial] with this proposal to spend millions on an unne[cessary] project.

The 17th annual convention of the Canadian Pape[r] Manufacturers Association was held at Bigwin Inn. [C. H.] Hobart, now president of Consolidated Paper Co[rp.] elected president.

Newsprint Overcapacity Cause of Trouble

An analysis of the newsprint industry showed that [from] 1913 to 1931, the average increase in consumption wa[s] but with wide fluctuations from year to year. It was ap[parent]

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that excessive capacity was the main problem. At the end of 1931 this excess was 1,700,000 tons more than the continent had ever absorbed—about 4,000,000 tons. The burden of idle capacity had become increasingly felt, yet increased overcapacity was met by ineffective price reductions that only aggravated the situation. Returning from England, F. L. Ratcliff said, "the people of Canada have talked themselves into a depression."

James H. Ross was appointed director of the Pulp and Paper Division of the Forest Products Laboratories of Canada, succeeding the late E. P. Cameron.

It was quite an event when Rolland Paper Co. celebrated the golden anniversary of the first fine paper mill in Canada. This mill was established at St. Jerome 40 years after J. B. Rolland started his stationery, book, store, and printing business in 1842. The interesting story of three generations of Rollands appeared in the September issue

The Woodlands Section, CPPA, held their Summer meeting on the limits of the Singer Manufacturing Co. near Thurso, Que. With papers read, discussions held, and demonstrations of equipment, the meeting was a pronounced success, concluding with a complimentary dinner given by the E. B. Eddy Co. at Standish Hall.

On September 10, G. T. Clarkson was appointed receiver and manager of Abitibi Power & Paper Co. Ltd. Protective committees were appointed by bondholders of Canadian Paperboard Ltd., and by bondholders and preferred shareholders of Price Brothers & Co. Ltd.

Archibald Fraser, president of Fraser Co. Ltd., dropped dead of a heart attack as he stepped forward toward a bird he had just shot near his hunting lodge. His nephew and the guide brought the body back to the camp in a canoe. Frank McHenry, superintendent of St. Lawrence Paper Mills, died of pneumonia at the age of 47.

In the November issue, Harold Crabtree, president of the Canadian Pulp and Paper Association, summarized the Imperial Economic Conference. One significant sentence:

"What is important is that a basis has been laid upon which a structure of Empire trade may be built and it is hoped that by setting up a movement of trade within the Empire there will be a gradual increase in the flow of trade throughout the world."

1933

This fourth year of the Depression saw newsprint production fall off by another 12% from the previous year's figure, with prices per ton dropping from $52 to as low as $38.50 per ton. Abitibi Pulp & Paper Co. operated only the Iroquois Falls and Sault Ste. Marie mills, but, in contrast, one number of this magazine was devoted to the Canadian International Paper Co., which employed 10,000, had $300,000,000 invested in its properties, and held 29,000 square miles of timberland producing 1,250,000 cords annually. Its four news mills had an annual capacity of 873,000 tons, and its sulphite pulp mills a capacity of 150,000 tons. In addition, 70 million sq. ft. of board was manufactured. These figures included the Corner Brook, Nfld., mill, which was part of the International chain of plants.

Business conditions being what they were at that time, it would unquestionably be more cheerful to look at a few personalities in the pulp and paper news of the day. K. S. MacLachlan was chosen to head up the Fraser Co., and Arthur A. Schmon was given the same post with the Ontario Paper Co. J. E. Vallillee, who at that time was working in the Shelter Bay office of the company "way down on Quebec's north shore," was awarded the Vice-President's Prize of the General Accountants Association for obtaining the highest marks of anyone writing the intermediate examinations that year. L. S. Henry succeeded G. D. Bearce as manager of the New Brunswick International Paper Co. at Dalhousie, and D. B. Chant, former manager of the Sturgeon Falls mill of Abitibi, took over the position of secretary-engineer of the Ontario Pulp & Paper Makers Safety Association from A. P[illegible] gane, who had held the post for 17 years. Harold Crab[illegible] again honored with the difficult job in bad times[illegible] presidency of the Canadian Pulp and Paper Associatio[illegible] he had also held in 1932. F. L. Mitchell of Abitibi was[illegible] as chairman of the Technical Section. F. J. D. B[illegible] crusader for forest management, died at the age of 7[illegible] attempt to preserve a portion of British Columbia's fo[illegible] its natural state eventually ended, for the most part,[illegible] ure.

The Quebec Limit Holders Manual contained som[illegible] opinions on forestry matters by the Quebec Forest In[illegible] Association's solicitor, one Louis St. Laurent, K.C. T[illegible] tario Paper Co. opened their electric steam plant [illegible] Thorold mill. The June issue of this publication was [illegible] to the modernization program followed in this mill[illegible] Lacroix interests acquired the St. George Pulp & Pape[illegible] New Brunswick, and Bowater's acquired the major int[illegible] Price Brothers & Co. Ltd., an arrangement which l[illegible] comparatively short time. Price Brothers' suit for $[illegible] in damages against the members of the Newsprint H[illegible] for failure to support the agreement all had signed v[illegible] missed with costs. This publication issued its thirti[illegible] niversary number in May, which contained recor[illegible] reminiscences of the industry since its inception.

1934

The year 1934 began to see a parting in the dark[illegible] which had hung over the industry since the start of [illegible] pression, as a number of mills began to reopen and ma[illegible] which had been idle for some time were started up[illegible] These included the Murray Bay Paper Co. at Clermon[illegible] (now Donohue Brothers), under the managership o[illegible] Sternberger, former manager of the Ste. Anne Pap[illegible] which was still down. Canadian Celanese purcha[illegible] Bonaventure Pulp Co. mill at Chandler, Que., chan[illegible] name to Premier Pulp & Paper Corp., perhaps in an [illegible] to shake off the bad luck which had dogged this mill w[illegible] than ordinary persistence since its inception and [illegible] several aliases. The Nipigon pulp mill of Inte[illegible] Paper Co. resumed production after 7 lean years of [illegible] and Great Lakes Paper Co. began to run full. N[illegible] machine was started at the mill at Fort Frances, On[illegible] Port Alfred, Que., mill reopened, with W. D. Bergeron [illegible] from Belgo at Shawinigan Falls as manager. W. D. [illegible] replaced him at the latter mill.

There were some interesting figures quoted to sh[illegible] how the mighty industry had fallen off in the depressio[illegible] The gross value of the industry's annual production wa[illegible] as $243,000,000 in 1929 and $123,000,000 in 1933. T[illegible] price of $40 reached for newsprint, the lowest since 1[illegible] sulted in a savings for publishers of $100,000,000 in t[illegible] 1933 as compared with 1929. This low figure, howev[illegible] resulted in the bankruptcy or reorganization of over [illegible] the Canadian newsprint industry. Using the year 19[illegible] base with an index of 100, the price of newsprint wa[illegible] while pig iron was 83.0 and cement 105.2.

Obviously operating economy was the watchword t[illegible] out the industry, and this was reflected in the title sele[illegible] an essay contest sponsored by this publication, "H[illegible] Manufacturing Costs Be Lowered?" This was won b[illegible] Askin, with M. L. Rubin of Springfield, Mass., in secon[illegible] Third prize resulted in a tie between E. Cowan an[illegible] Swasey; R. P. Egerton was fourth, and A. E. H. F[illegible] fifth. A special commendation was given to John H.[illegible] The February cover of this magazine reproduced [illegible] Bartlett print of the paper mill at Lorette, Que., just [illegible] Quebec City. This mill began operations prior to 18[illegible] 1871 it employed 30 persons and the annual output was[illegible] at $27,000. It was burned in 1890 and did not resume [illegible] tion. In contrast, an order was placed by Edward[illegible]

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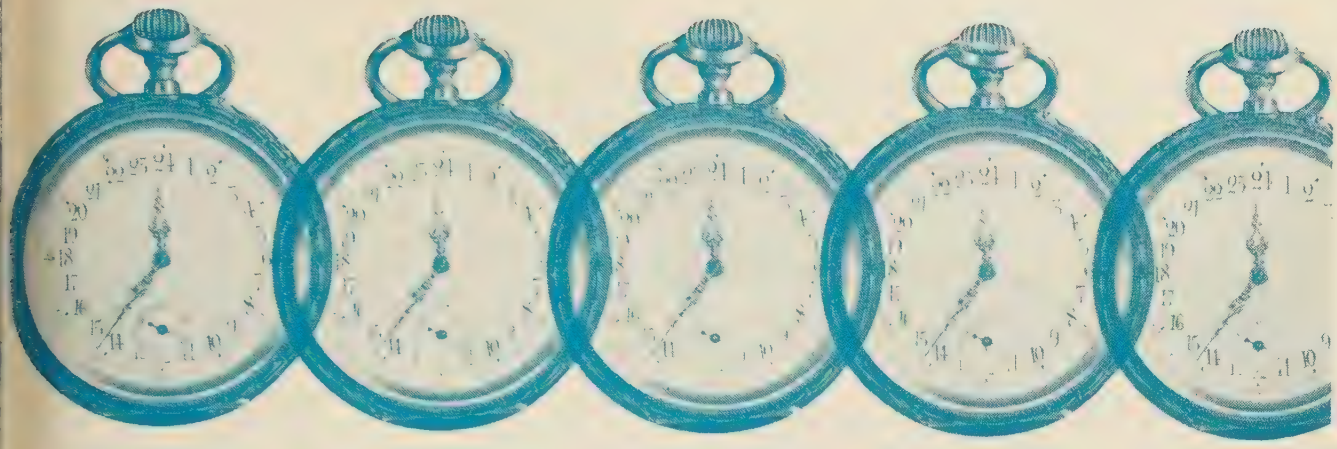

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Ltd., Kemsley, England, with the Cameron Machine Co., of Canada Ltd. for a 310-in. winder. The old Stutt paper mill at Greenville, Ont., which had begun operations in 1813, was also burned. This mill had a 66-in. cylinder machine producing 7 tons of strawboard daily.

Editorial content of the magazine reflected the changes and improvements of the times. The Trimbey consistency regulator and freeness recorder were described, and also the Haug refiner. Aircraft and radio teamed up to provide better and quicker forest protection against fires. A number devoted to marine transportation of paper contained articles by J. Newell Stephenson and Captain Fred Wallace, well-known author of "Wooden Ships and Iron Men," who recently retired as the editor of *Canadian Fisherman*. A. T. Hurter, then an engineer on the staff of the Abitibi mill at Iroquois Falls, Ont., contributed an article on "Antifriction Bearings in Pulp and Paper Mills."

Brigadier General John B. White, D.S.O. was elected president of the Canadian Pulp and Paper Association. E. W. Backus, of the Backus-Brooks enterprises that became the Minnesota & Ontario Cos., died.

1935

Looking over our notes on the 1935 issues of *Pulp and Paper Magazine of Canada* we get the impression of an industry which was down, but not out; holding on, somewhat groggily, to its shreds of consciousness. As far as production was concerned, the one bright spot seemed to be the rebuilding of the converting plant of Garden City Paper Mills Co. Ltd., which had been burned in 1933. Liquidations and reorganizations were still the order of the day. Bowater's repeated its offer to Price Brothers for the purchase of its assets, offers which had been made sporadically through 1933 and 1934. Brown Co., which included its Canadian subsidiary, Brown Corp. at La Tuque, Que., sought to reorganize. Many people figured that here was a good case of the offspring supporting the parent. There were four offers for the assets of Great Lakes Paper Co. Ltd., the one made by Gefaell and Aldrich receiving the most prominent notices, notices that were to run for a considerable period. Although the proposed deal seemed to have somewhat shoestring specifications, it managed to survive a refusal by the Ontario government and other vicissitudes before its final demise in a later year. The magazine reprinted some caustic comment by Frank Carrell, editor of Quebec's *Chronicle-Telegraph*, on the newsprint situation. He pointed out that price cutting would not sell a pound more paper—that the demand, based on advertising linage, was the determining factor. He also bemoaned the fact that Canada was fast depleting her forest assets to keep America's papers on the stands—and at a heavy financial loss, at

Brigadier General White was re-elected president Canadian Pulp and Paper Association.

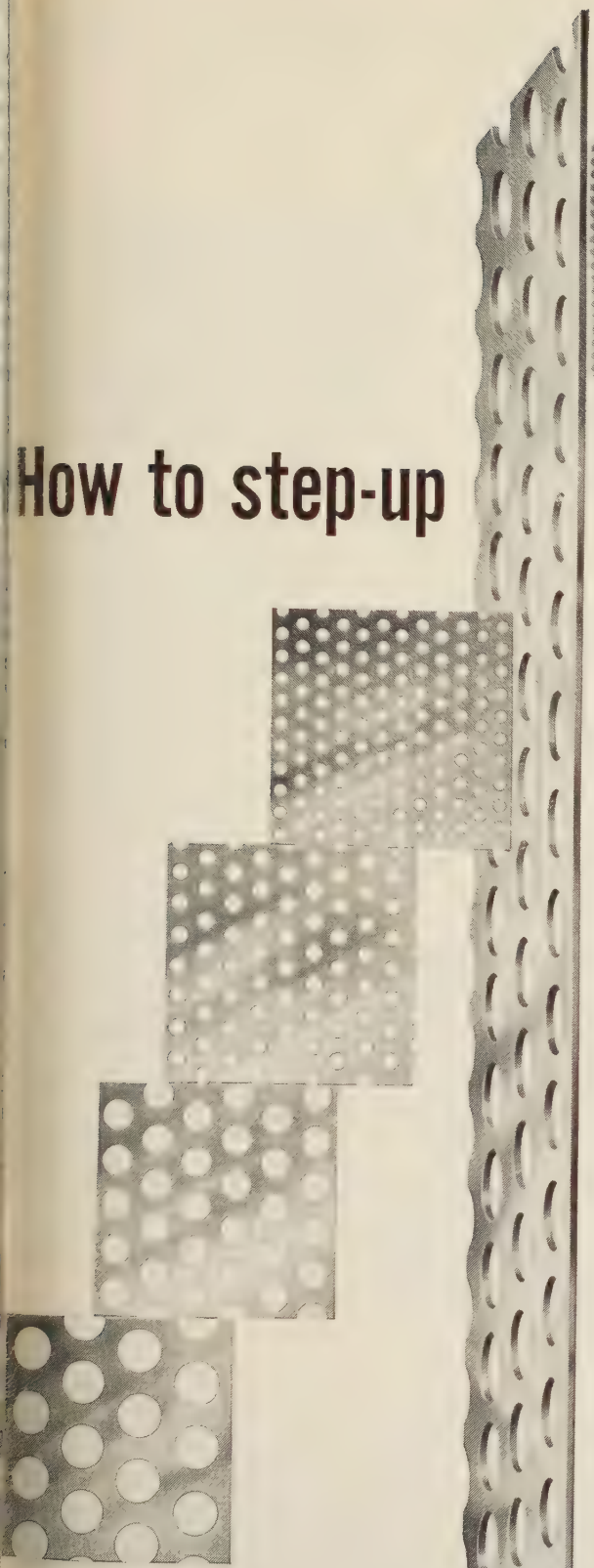
Some interesting work was done in the editorial fiel industry, including the second revision of the "Pulp an Textbooks," handled, as usual, by the editor of this m O. E. Sharpe, who put in many years of service w Quebec Workmen's Compensation Board, wrote an discussing merit rating plans, which he did not consid workable. This is still a point of heated discussion Ontario and Quebec government and company officia Quebec ready and able to show that such a plan can to work. Human nature being what it is, the philan side of accident prevention work cannot compete v pocketbook side—and it is on the latter target that has trained its guns, with a resultant sharp reductio cident costs and rates. W. A. E. Pepler, then with ternational Paper Co., wrote an article entitled " Logs," and R. S. Kellogg and H. C. Herty engaged in debate on the possibilities of the utilization of south for the manufacture of newsprint.

Death took quite a toll of the industry's leaders, in Edwin S. Crabtree, at 87 years of age, Thomas Ford neuf at 77, S. J. B. Rolland at 83, and Adolph Ochs, p of the New York *Times*, in his 78th year. Arthur L also died at the age of 71. An aftermath of the death B. Barnjum in 1933 was the loss of his West Coast t serve. He had not made any provision for it in his had not deeded it to the government, fearing that the cut his precious holdings. The only hope for preserv any of it rested in the 200-acre tract deeded to hi Chandler Hovey, of Boston.

1936

The general tone of the year 1936 seemed to be watchful waiting, tinged with optimism. The rash ganizations and other signs of instability had pre ceased, the paper industry having been dewatered tively as if it had been put through one of its own Actually, the only amalgamation of any consequence of Bowater's and Edward Lloyd, Ltd. in England, a which Bowater's acquired, among other assets, the largest paper machine, a 320-in. giant at Lloyd's mill, rated to run at 1400 f.p.m. For the new mil Comeau, Que., the Ontario Paper Co. ordered two machines from Dominion Engineering. While these the largest in the world, they proved to be up with the

Lake Sulphite plant at Red Rock, Ont., now operated by the Brompton Div. of the St. Lawrence Corp.



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You can be sure of that because the plates are made of Monel and Inconel.

These metals never rust. They resist corrosion caused by acid and alkaline stocks and solutions. They're strong and tough. They resist abrasive wear.

Consider the experience of Crown Zellerbach Corp., West Linn, Oregon . . .

They had several problems. Short screen plate life was one. And inconsistent quality of book groundwood another.

Plates were corroding beyond use in less than 5 months. And screening efficiency, of course, dropped as the plates got older, and corrosion bit into the perforations.

In the search for plates that would give them better screening, the mill tried several made of Inconel. These were fabricated by Charles Mundt & Sons, Jersey City, N. J., a company with more than 84 years of experience in the production of perforated metals for industry.

These Inconel plates turned in an amazing performance. So the mill bought more, bringing the total to 40. *Not one gave less than 16 months of continuous service, nine were on the job at least 25 months, and some lasted more than three years without any measurable enlargement of the perforations.*

Keep this story in mind. And the next time *you* need screen plates, switch to Monel or Inconel. You'll never regret it.

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Here are five selections from a large line of stock patterns available in corrosion-resisting Monel and Inconel screens. The fabricator, Charles Mundt & Sons, Dept. M, Jersey City 4, N. J., will be glad to send you a complete catalog.

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INCO TRADE MARK

Bowater's Corner Brook mill, acquired from Canadian International Paper Co.

as far as speed and production were concerned. The Belgo mill was featured on a "Little Forum of the Air" broadcast, in which typical sounds heard in the papermaking process were put on the air, starting with the swirling roar of the St. Maurice River in flood at Shawinigan Falls, through the slasher mill, barking drums, chippers, grinders, and machine room, which included a sample of couch roll hum, whistle signals for a paper break, and the comments of the machine crew while the paper was being passed through the driers. As this break was done on purpose for broadcasting, we hope that the crew's comments were properly expurgated in view of the extra work involved.

Outstanding articles during the year were those on the Minton vacuum drier, one by Marlen Pew, retired editor of *Editor and Publisher*, on television, and a series by Harry Spencer, manager of the Beauharnois division of Howard Smith Paper Mills Ltd., on a European trip, the most interesting of which were on handmade paper in England and on papermaking in general in Russia, which, at that time, had a somewhat Heath Robinson air about it. In the pen-is-mightier-than-the-sword department R. J. Chambers of Anglo-Canadian Pulp & Paper Mills Ltd. won the essay contest sponsored by this magazine on the subject of ways and means to avoid losses incurred through nonrecovery of industrial wastes—a timely topic, in view of the depression. At the beginning of the year the *Pulp and Paper Magazine* reduced its size to 9 by 12 in. at the suggestion of the Technical Section, which found the previous large format somewhat clumsy.

R. A. McInnis was elected as president of the Canadian Pulp and Paper Association, to succeed Brigadier General John B. White, who had served for two terms through tough times.

W. J. Finlay, president of Strathcona Paper Co. Ltd., celebrated his 64th year as a papermaker. Deaths during the year included that of King George V and Noah Timmins, president and founder of St. Lawrence Paper Mills Co. Ltd.

1937

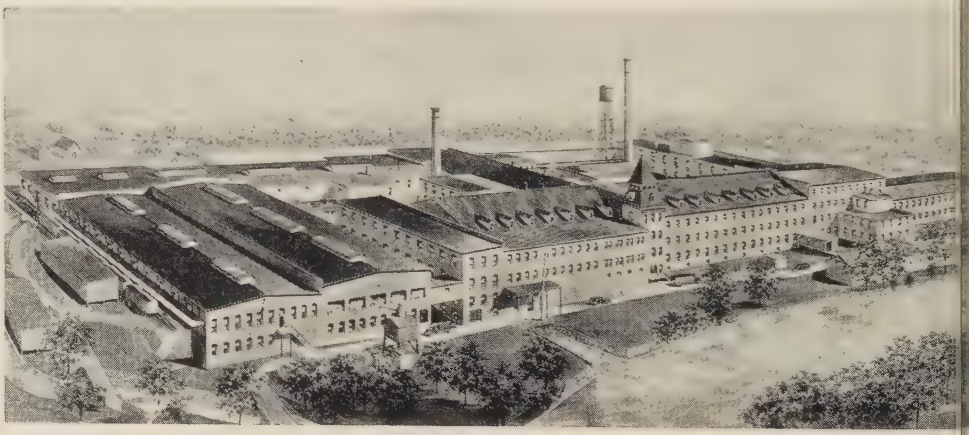
This year started off with a spurt in the right direction, but lost momentum and ended up with a newsprint production o 3,190,000 tons as compared 3,645,000 tons for 1936. In spite decrease, the general tone of the in was better and the so-called "rec did not have too much effect. T at Chandler, Que., now operat Anglo-Canadian under the na Gaspesia Sulphite Co., opened a down years, and the Fort Willia of the Abitibi group also reo Construction proceeded on the Sulphite plant at Red Rock, Ont John Stadler as president and Hurter as chief engineer in cha construction and assistant mill ma Mr. Hurter had previously been re engineer of the Abitibi mill at Ir Falls. Price Brothers finally suc in effecting its reorganization, a Gair Co. bought the mills of Ca Paperboard Ltd. in Toronto and ford, Ont. The Port Mellon, B. C on Howe Sound went into operation, manufacturing kra with purchased wood and plans were formulated for do the size of the Brown Corp. pulp mill at La Tuque, Qu

R. A. McInnis was re-elected to another term as pre of the Canadian Pulp and Paper Association, and H Kennedy became operating head of the Quebec Forest tries Association. G. J. Lane resigned as manager Gatineau mill of Canadian International Paper Co. a succeeded by J. C. Monty. Jack West became manage Three Rivers mill, replacing I. H. Copeland, who mo into the managership of the company's Canadian new division. C. H. L. Jones became president of Price Br succeeding Gordon Scott, and moved to Quebec to ta the active management of the newly reorganized co Deaths during the year included that of C. Nelson Ga merly manager of the Garden City Paper Mills and mil ager of Interlake Tissue Mills, Charles F. Buss, gen perintendent of Provincial Paper, and Sir Frederick B England, who had run into considerable financial di in trying to operate pulp mills in Quebec and the Mari

The editorial content of the magazine was gradually on the appearance it has today, with leading and te articles by many who are still active in the field. No st innovations were put forward, but the trend toward technical development and closer process controls w more noticeable.

1938

There was a firmer tone noticeable in business, and pulp and paper industry in particular, in 1938. R



Rolland Paper Co. mill at St. Jerome, Que.

How Brown Company Pulps Helped Put...

Through the pictures and text of this handsome brochure, the Aluminum Company of America takes you on a guided tour of its revolutionary new 30-story building in Pittsburgh—the first aluminum skyscraper in America.

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tions, improvements, and additions were extensively made during the year. British Columbia Pulp & Paper Co. Ltd., completed a large program in connection with the refurbishing of both their Port Alice and Woodfibre mills. Ontario-Minnesota spent $200,000 on its Fort Frances, Ont., plant, and Howard Smith Paper Mills finished disbursing $1,655,000, mostly on the Cornwall, Ont., and Windsor Mills, Que., establishments. Ontario Paper Co. installed a million-dollar wood handling plant at Heron Bay, Ont., including a barking plant, with a model townsite adjacent to it. One stabilizing influence was the fact that William Randolph Hearst ran out of cash. His annual newsprint purchase, amounting to over $20,000,000, gave him a tremendous bargaining power, which he did not hesitate to use to the utmost to pare down the price as far as possible, thus even forcing mills who did not sell to him to dispose of their production at prices competitive with the rate stipulated in his agreement. His lack of the money to back up his offers forced him to rely on bank financing and long-term credit arrangements, so that he was able to fare little if any better than other newspaper publishers as far as the cost of his newsprint was concerned. Newsprint prices at that time varied between $48 and $50 a ton.

Other changes affecting mills were the purchase by Bowater's of the Corner Brook, Nfld., mill of the Canadian International Paper Co. Liquidation of the Lake Sulphite Co. at Red Rock, Ont., was planned. The Quebec North Shore Paper Co. mill at Comeau Bay, Que., opened under the managership of G. J. Lane formerly manager of the Canadian International Paper Co. mill at Gatineau. It is interesting to look over the number devoted to the dedication of this mill and townsite and to see how many of the top personnel are still there—a credit to the policies of the company as far as employee relationships are concerned and to those who were instrumental in selecting the staff. Consolidated Paper discussed the sale of their Anticosti holdings, finding th of making wood on the island too high.

Personnel changes included the appointment of W. S. as managing director of The E. B. Eddy Co., to succeed Caesar. Mr. Kidd was a former chairman of the Tec Section. Julius A. Draper was appointed to succeed th J. H. Turner as director of safety for the Consolidated J. H. Hinman was elected president of Canadian Interna Paper Co., with S. L. DeCarteret as general manager. Paukert, manager of the Fort William mill of Abitibi, r to Iroquois Falls in the same capacity. J. J. Herb of minster Paper Co. on the West Coast celebrated 50 ye the paper industry, and R. A. McInnis was elected pre of the Canadian Pulp and Paper Association for the time. W. J. Finlay, president of Strathcona Paper Co. as did Charles Herty, who succeeded in evolving a proc the conversion of southern slash pine into newsprint.

Articles during the year included one in which A. K. and Leo Kelly of Price Brothers collaborated on the sub mechanized logging. Air mapping of woodlands holdin also described. Dilts hydrafiners and the Cowan and C air-handling systems were written up. W. R. Brown of I Co. gave a talk on "Hardwood Pulpwood" from the point of harvesting it in the bush. He told about experi made in splitting knotty hardwood bolts by the use of mite or black powder.

1939

Looking backwards to the 1937 "recession" from th tage point of 1939, it was possible to see that the low poi been passed in the former year and that business wa nitely on the upswing in 1938. Repercussions from

Bathurst Power & Paper Co. mill at Bathurst, N. B.

"VIRGINIA" ZINC HYDRO

cuts groundwood bleaching costs 50%
increases brightness 12 points

That's the kind of brightening job "Virginia" can do on your groundwood pulp. That's the kind of savings which use of our reducing agent puts in your pocket.

Some mills have gained as much as 13 points, at one-third the cost of oxidizing bleaches. Saving: a cool $8 per ton. Bleaching with our zinc hydro can be done for as little as 60c per brightness-point per ton. And brightening is *permanent*—there is no reversion of color.

Low-cost "Virginia" Zinc Hydro is non-corrosive, stable in storage, easy to use in the plant. No expensive special equipment is needed. Many auxiliary chemicals are eliminated. "Virginia" Zinc Hydro works just as well in a small, non-integrated mill as it does in a large, continuous-production groundwood operation.

Call on us for proof of all this. The technical and practical knowhow of our experts is at your disposal. Write us today.

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hard times were still being felt, however, one being the authorization of the sale of the assets of the Lake Sulphite Pulp Co. The Nipigon, Ont., mill was leased to the English River Pulp & Paper Co. for a 6-month period, with an option for renewal. Columbia River Paper Mills bought the Vancouver Kraft Co. Ltd. plant at Port Mellon, B. C., for the sum of $500,000, which represented about 40% of the total of the bondholders' claims. Alliance Paper Mills Ltd. bought the Don Valley Paper Co. A severe block pile fire at the Ste. Anne mill at Beaupre, Que., completes the really bad news, except that the price of newsprint remained at $50.

Improvements made in the year 1939 included alterations and additions to the mills of the Ontario Paper Co. at Thorold, the Quebec North Shore Paper Co., Bathurst Power & Paper Co. Ltd., Gulf Pulp & Paper Co., and Anglo-Newfoundland Development Co. Ltd. Rolland Paper Co. installed a new paper machine, 106 in. wide, at their mill at St. Jerome, Que. The Masonite Co. of Canada Ltd. plant was being built on the International Paper Co. property at Gatineau.

J. Newell Stephenson received the TAPPI medal for his 20 years spent on the pulp and paper textbooks, and other services in the field of education. W. L. Bennett began his second term as president of the Quebec Pulp & Paper Safety Association, in which office he is still continuing. F. A. Sabbaton became president of Dryden Paper Co. Ltd. L. J. Belnap, president of Consolidated Paper Corp. Ltd., issued an "Annual Report to Employees," wording it so that they could readily understand the company's position, plans for the future, and prospects for its personnel. John Stadler, Jr. was killed in an airplane crash.

War clouds were gathering on the other side of the water, and in spite of Chamberlain's intention to "make Britain so strong that nobody dare attack her," the storm finally broke near the end of the year. Although, actually, the situation was much graver than in 1914, there did not seem to be the same urgency, and everyone seemed to adopt a policy of "watchful waiting."

1940

Outside of some staff adjustments made necessary by enlistments or by the calling of paper mill executives for position in war work, the European conflict did not loom large on the scene during 1940. Notes made during the events of that year read much the same as for any other year which involved an upward trend in business.

F. G. Robinson, president of the Riordon Sales Corp. and vice-president of the Canadian International Paper Co. became presi lent of the Canadian Pulp and Paper Association, succeeding R. A. McInnis, who had held the office through four worrisome years. The CPPA was reorganized later in the year to provide more effective service for its members, with Mr. McInnis and Brigadier General White as vice-presidents and an executive committee composed of Harold Crabtree, S. F. Duncan, S. L. DeCarteret, Jean Rolland, R. L. Weldon, C. R. Whitehead, and L. F. Winchell, Col. John H. Price thanked Mr. McInnis for the tremendous job he had done in steering the industry through such troublesome times. G. G. Gale succeeded V. M. Drury as president of the E. B. Eddy Co. on the latter's departure for a position in defense work. H. S. Foley became president of Powell River Co. Ltd., and B. D. Millidge was chosen as vice-president and assistant general manager of Alliance Paper Mills Ltd., with A. E. H. Fair succeeding him as manager at the Cornwall mill of Howard Smith Paper Mills Ltd. Albert Maclaren of the James Maclaren Co. Ltd. died. John F. Taylor entered his sixtieth year as an employee of The E. B. Eddy Co. His last three positions with the company were secretary, sales manager, and vice-president.

The Masonite mill at Gatineau opened, as did the Winnipeg mill of Building Products Ltd. Bathurst Power & Paper Co. began operating its new black liquor recovery plant. The Canadian Paperboard mill at Frankford, Ont., which had been closed since 1930, was reopened and converted into a manufacturing plant by the Bata people from Czechoslo In the interim there had been some pulp produced in th for 6 months during 1931 and 1932 and there were par jobs for some when Gair Co. of Canada Ltd. took ov mill in 1934. During 1938 pulp was again produced capacity, but the paper mill never reopened. Sidney R & Paper Co. Ltd. began operations again after a disa fire. Another Bathurst installation of interest was the tion of two new kraft digesters, which were brought to th by rail, squeezed around a right-angle turn between ings, raised to a vertical position, and moved through sageway which allowed less than 2 in. of clearance. S ployees were killed and two severely injured during a the Edmundston, N. B., mill of Fraser Co. Ltd. The me gone up onto a conveyor to help to extinguish the fire wh steel cable parted due to the heat. A snowmobile ma trip from Murray Bay to Comeau Bay, Que., in 18 hr. ov right of way of the highway being built between thes points. A. Koroleff wrote on logging mechanization, an Wilson of Anglo-Canadian Paper Mills Ltd. showed that were 204,575 sq. miles of forest area in Quebec below the parallel. The Technical Section celebrated its twent anniversary.

1941

Production of newsprint again followed the upsw curve of general business, being 5% higher in 1940 th 1939. F. G. Robinson was re-elected to guide the destin the Canadian Pulp and Paper Association for another R. A. McInnis retired from his position with Anglo-Can Pulp & Paper Mills and affiliated companies on account health being succeeded as general manager by Elliott Mr. McInnis died before the end of the year. Mr. Litt chosen as the Director of Technical Personnel by the D ment of Labor in an attempt to inventory Canada's ass the war effort as far as trained technicians were con The April issue of the magazine was devoted to those of dustry who were in the service of their country, and truly an impressive showing. The lethargy which mar beginning of the war had disappeared, and the mill selves got into the fight by manufacturing artillery and components in their machine shops under the guidance Wartime Machine Shop Board. A. T. Hurter becam of the huge shell-filling plant at Bouchard, Que., just o Montreal, operated by Defense Industries Ltd.

Aubrey Crabtree was chosen as president and genera ager of Fraser Co. Ltd., and Harold Crabtree was re-e as president of the Canadian Manufacturers Assoc Douglas Jones joined the Technical Section staff as secr engineer. The Cap de la Madeleine mill of Consol Paper Corp. Ltd. reopened after eleven years of id Deaths during the year, beside that of R. A. McInn cluded that of Louis Armstrong of Consolidated and th grandsons of John R. Booth within 2 months of each ot

In the magazine there ran a series of articles by D. C. entitled, "Planning Your Career in the Paper Indu based on the course he followed as a sales trainee wi International Paper Co. The Roberts grinder was also w up.

1942

The first story to break in 1942 was the defeat and c of the Canadian force at Hong Kong, which includ Winnipeg Grenadiers and Quebec City's Royal Rifles o ada. Three majors of the latter unit had been employed industry—Tom MacAulay and Maurice Parker at Canadian and Jack Price, later promoted to colonel, o Brothers. Many other paper people were included i group, and it was many months before some of them heard from.

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For details, write for Technical Bulletin P-2.

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Sodium Sulfate
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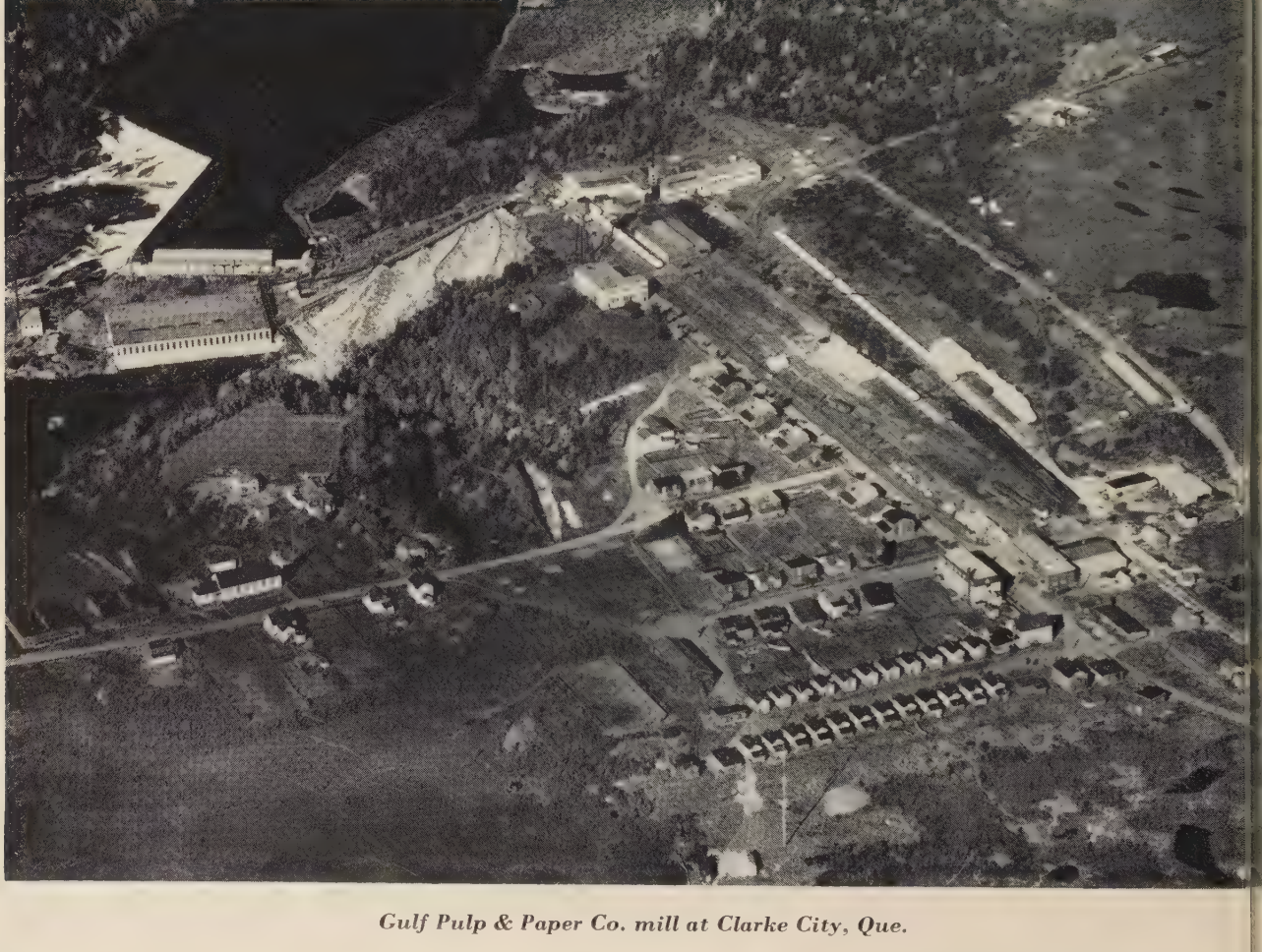
Newsprint production hit 3,445,920 tons in 1941, about 7000 more than in 1940. E. Howard Smith became president of the Canadian Pulp and Paper Association when R. L. Weldon resigned to devote his efforts wholly to war work. R. J. Askin moved up from mill manager of the Thunder Bay mill of Abitibi Power and Paper Co. to the post of assistant manager of mills. C. H. Sage became president of Spruce Falls Power & Paper Co. Fred Hogan became manager of the Port Alfred mill of Consolidated Paper Corp. Ltd. Elliott Little of Anglo-Canadian moved up to be Director of National Selective Service for the Dominion from his previous post as Director of Wartime Technical Personnel. W. A. E. Pepler left his position as manager of Quebec Forest Industries Ltd. to take over the managership of the Woodlands Section of the Canadian Pulp and Paper Association. Deaths during the year included those of A. A. MacDiarmid, chief engineer for Price Brothers and J. A. Hanrahan, general manager of Gulf Pulp & Paper Co. of Clarke City, Que.

The Brompton Co. acquired the Red Rock, Ont., mill of the old Lake Sulphite Pulp Co., and began its renovation. The additions and improvements at the Gulf Pulp & Paper Co. were written up by members of the staff there, and considerable space in the magazine was devoted to the new sectional electric drives in the newly reopened Cape mill of Consolidated Paper. Steam boilers to burn coal were installed at both the Kenogami and Riverbend mills of Price Brothers & Co. Ltd. to replace the loss of their secondary power source electricity—which was being diverted to the manufacture of aluminum at Arvida and to other wartime needs. A considerable improvement program was also completed at the Sorg Pulp Co., Port Mellon, B. C.

Articles appearing during the year included a series by J. N. Franklin, then with the Quebec North Shore Paper Co., on pulp and paper mill instrumentation. The July number was devoted to a series of summary articles by the leaders in fields on the technical progress made during the past 40 by the pulp and paper industry. Quentin Reynolds, known American writer, had given a speech extolling th work being performed by the Canadian Forestry Co England and Scotland to help the British war effort. was reprinted in the magazine with illustrations of the being performed under the direction of Brigadier G White, former president of the CPPA.

1943

The Second World War loomed as a larger and larger in Canadian life in general and the pulp and paper indus particular. The impressively long list of names in the Roll of paper mill men on active service gives conclusive of the industry's contribution. The newsprint allocatio tem and the emphasis placed on the importance of sugge for saving critical materials also illustrate the war's in on the industry. R. L. Weldon, president of the Can Pulp and Paper Association, resigned to become new administrator for the Wartime Prices and Trade B George S. Pincott of the CPPA staff was on leave to f position of pulp administrator for the same governmen trol body. James O'Halloran of Anglo-Canadian Pul Paper Mills received a well-merited medal for his idea o ing the paper mill machine shops handle war work con an idea which germinated into the Wartime Machine Board. Howard Kennedy became a major-general and termaster General of the Canadian Army. S. L. de Ca was awarded the C.M.G. by the King for his part as D Minister of National Defense for Air. Female help ma appearance in positions hitherto sacred to the male of th cies at the Ocean Falls mill of Pacific Mills Ltd., at Lakes Paper Co., at the Abitibi Thunder Bay mill, at



Gulf Pulp & Paper Co. mill at Clarke City, Que.

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MANY PAPER MILLS have turned to Celite* diatomite powders as the simplest and most economical way to counteract pitch trouble. Celite pays for itself because at least 50% of the Celite is recovered in the finished sheet. In addition, the elimination of down time, due to pitch, results in further savings.

A test run in your mill will quickly demonstrate these advantages of Celite. Because of Celite's porous, absorbent characteristics, the microscopic particles surround and coat the pitch, prevent it from adhering to machines. And since the Celite-coated particles are largely retained in the sheet, they do not build up in the stock or white water system.

Celite is also used in other ways to improve finished sheet. It can increase opacity up to 50% . . . it can add higher brightness at lower cost . . . and provide better ink receptivity and absorption, too.

To prove these advantages of Celite, a Johns-Manville Celite Engineer will gladly assist you in making trial runs in your mill. There is no charge for his services. Simply write Johns-Manville, Box 60, New York 16, N. Y.

*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville CELITE PRODUCTS FOR THE PAPER INDUSTRY

River, and at Bathurst in New Brunswick. Many of the jobs they filled involved sampling, testing, etc.—but at the Canadian International Paper Co. mill at Temiskaming they worked side by side with the men poling 12-ft. logs onto the jackladder.

Brown Co. and Brown Corp. were finally reorganized, with E. G. Coburn as president. Herman Schanche took over the woods managerships of both companies. The KVP Co. purchased the old Espanola mill from the Abitibi Power & Paper Co. Ltd. for the manufacture of vegetable parchment and other forms of paper in Canada, and another ghost mill town was resurrected. Hearst offered a settlement at the rate of 50¢ on the dollar against his indebtedness of 5 millions. The Carnegie Hero Fund Commission awarded eight bronze medals to D. E. Read, mill manager of International Fibreboard Ltd. and seven employees for their courageous work in rescuing men who had been overcome by gas at the bottom of a tank of tailings. It is remarkable how several fatalities were avoided, as at one point in the rescue attempt there were more men lying on the floor of the tank than those who were originally victims of the fumes. Only two of the men involved lost time from work.

E. Howard Smith succeeded R. L. Weldon for the balance of the latter's term as president of the Canadian Pulp and Paper Association. F. R. Thorn became vice-president of Price Brothers Sales Corp., and R. J. Askin took over the job of managing the Abitibi mills. Deaths during the year included James Shanley, paper division manager for Price Brothers, resident at Kenogami, and W. J. Wallace, former manager of the Cornwall mill of Howard Smith Paper Mills Ltd.

1944

The year 1944 reflected the continuing world-wide conflict, but by this time the industry was pretty well organized for it, and was turning out large quantities of much-needed paper and pulp products and carrying on with the Wartime Machine Shop Board work. In this connection the E. B. Eddy Co., J. Ford & Co. Ltd., and Anglo-Canadian Pulp & Paper Mills Ltd. received awards for the excellence of their work and for the ingenuity and initiative displayed in meeting the diverse problems met with. S. L. de Carteret resigned his position as Deputy Minister of National Defense for Air. A. D. Piper returned to the Howard Smith mills at Cornwall as a paper tester—minus his hands, which he had lost on active service.

Nature aimed a good punch at the industry by coming up with the lowest water levels in 30 years, which seriously hampered the drive for more pulpwood, already in short supply, and also caused power shortages. St. Lawrence Corp. assumed control of Lake St. John Power & Paper Co., altho it was some time before all the kinks were ironed out of merger. George H. Tomlinson wrote an important article titled, "The Magnesium Bisulphite Pulping Process— Answer to the Sulphite Waste Liquor Problem." John Sta was feted with a party on the occasion of his seventieth bi day. When he tried to cut the cake, he found that it wa iced block of pulpwood. His birthday was April 1.

Personnel changes during the year included the move c Norval Hunter to the KVP Co. mill at Espanola, Ont., a sistant to the president. J. D. Gilmour joined the H. R. M Millan organization on the West Coast. Wentworth Br became vice-president of the two Brown enterprises in ch of production, and Herman Schanche occupied a similar p tion in the woodlands end of the companies. H. Grinstac signed as manager of the Red Rock mill of the Brompton & Paper Co. and was succeeded by F. D. Taylor. H. A Gregory became general superintendent at East Angus fo same company. Major General Howard Kennedy went the Ontario Paper Co. as vice-president in charge of w lands, and was succeeded at Quebec Forest Industries Ltd W. A. E. Pepler. S. J. Fisher resigned as general supe tendent of Price Brothers Kenogami mill due to ill health, Joseph Edwards took over.

1945

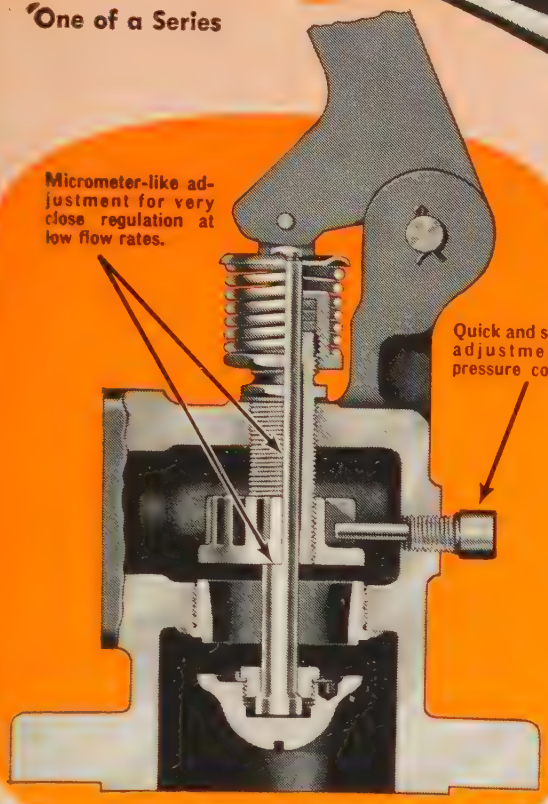
The year of the war's end saw a number of outstanding provements in techniques and equipment both in the and in the woods. These included, among others, Jon screens in the mills and Drott skid loaders in the bush. Ambridge was appointed president of the Polymer Cor crown company operating a large synthetic rubber plan Sarnia, Ont. The Canadian Pulp and Paper Association reorganized with R. M. Fowler as president on a more or permanent basis with the office of chairman to be fille election each year, with R. L. Weldon starting off on this arrangement. A. E. Cadman became general manager stead of secretary and the Association was revamped to greater service to its members. Newsprint was selling at ton.

Personnel changes included the election of Elliott M. L as president of Anglo-Canadian Pulp & Paper Mills L George M. Hobart became executive vice-president of C solidated Paper Corp., with R. Collins, as manager of m facturing. A. George Jacques was appointed assistant ge manager of St. Lawrence Corp. and Julian Merrill moved Ste. Anne Power Co. to Red Rock, Ont., as woods manage the Brompton Co. there. A. E. H. Fair took over the presidencies of both the Don Valley and Alliance Cos. i Howard Smith organization.

Marathon Paper Mills of Canada Ltd.

One of a Series

Reasons Why DIAMOND BLOWERS Assure CLEANER BOILERS at LOWER COST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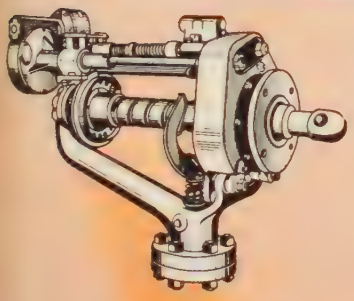

Diamond Model IR
Short Retracting Blower

When it is necessary to reduce blowing medium pressure to proper blowing range, the Diamond Adjustable Pressure Control device offers the utmost in economy, convenience, accuracy and dependability. It is fully effective even at very low flow rates.

Adjustment is readily made without removing the valve or opening flanges. Simply take out the plug and insert a screw driver; use the serrations on the control disc to screw it up for higher blowing pressure . . . down for lower pressure. Full valve opening is always maintained thus avoiding wire drawing. Throttling is at the back seat so that the main seat is spared this damaging action. No orifice is needed in the line.

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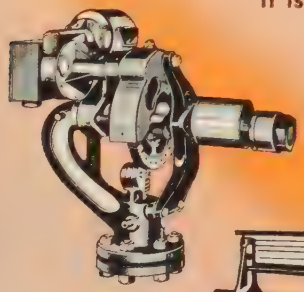

Diamond Model G9B
Automatic Valved Blower

DIAMOND POWER SPECIALTY CORP.

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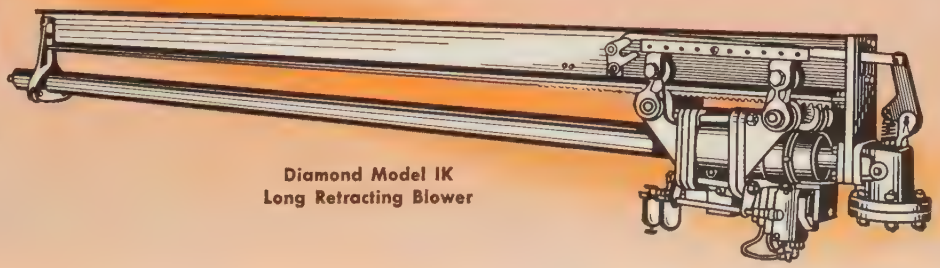
Diamond Specialty Limited, Windsor, Ontario



Diamond Model IK
Long Retracting Blower

6775

D. C. B. Thorne retired from his position at Hawkesbury, and died later in the year—a loss to the industry of one of its top men. Major M. R. McCracken, woods manager of Donohue Brothers, died at the pulp and paper convention. He distinguished himself in World War One by winning the Military Medal and Bar in the ranks, and, on receiving his commission, proved that he still had what it took by winning the Military Cross and bar. In World War II he recruited and commanded a company in the Canadian Forestry Corps. The wartime commander of this corps, Major General J. B. White, also died in 1945, as did Harold Hibbert, Mrs. E. B. Eddy professor of cellulose chemistry at McGill, and R. M. Kenny, president and general manager of the James Maclaren Co. Ltd.

1946

The flood tide of postwar demand for paper resulted in an extensive program of refurbishings and reopenings of mills already in existence, plus many new mills either opening or definitely planned and construction started. The Cap de la Madeleine mill of Consolidated Paper Corp. Ltd. was one of those in which production was resumed after a considerable shutdown. The Abitibi mill at Sturgeon Falls underwent a considerable face-lifting. New mills opening included International Plywoods Ltd. at Gatineau, which joined the paper mill, Masonite and International Fibreboard mills on the extensive Canadian International Paper Co. property just below Ottawa. Marathon Paper Mills of Canada Ltd. blew the first digester of unbleached sulphate pulp in September and the Red Rock mill of the Brompton Co. and the KVP Co. at Espanola all got rolling in Ontario. Changes in mill organizations included the purchase of the Booth mills by The E. B. Eddy Co., now being operated by the British biscuit boss, W. Garfield Weston. The Port Royal Pulp & Paper Co., located beside the Reversible Falls at Lancaster, N. B., became the St. John Sulphite Co. when acquired by the Lacroix interests. Mills planned included one for Fraser Co. Ltd., at Newcastle, N. B., the LongLac Pulp & Paper Co. Ltd. mill at Terrace Bay, Ont., and the Bloedel, Stewart, and Welch Ltd. mill at Port Alberni, B. C.—all on unbleached sulphate. Important new machinery installations included Flakt driers for sulphite pulp manufactured for sale at the Thorold and Comeau Bay mills of the McCormick interests and a Minton drier on the new machine at Brown Corp., La Tuque, Que. A fire destroyed the groundwood mill at St. George Pulp & Paper Co. in New Brunswick and the No. 2 mill of J. Ford & Co. at Portneuf, Que., was practically gutted. This disaster furnished one of the finest examples of community spirit and cooperation between the English and French residents of a stricken community when everyone voluntarily pitched in to help clean up the mess and to get the mill into production again. This took over 200 man-days of dirty work, but this contribution got the mill going in an almost unbelieval days after the fire.

Staff changes of import during the year included the f tion of Stadler, Hurter & Co., with A. T. Hurter joining with John Stadler. B. F. Avery left his position as manager of Great Lakes Paper Co. to become vice-pre and general manager of The KVP Co. Ltd. Jim Fear b mill manager of St. John Sulphite Co., taking Harry A with him from the Gaspesia Sulphite Co. mill at Cha Que. Romeo Comette became divisional manager at T of The Ontario Paper Co., and William H. Palm left Bro to go with Hinde & Dauch in Toronto as assistant to th eral manager. The Pacific Coast branch of the Tec Section, CPPA was formed.

Death called no less than three former presidents Canadian Pulp and Paper Association during 1946, nam J. Campbell of Canada Paper Co. at 82, George M. Mc Consolidated at 77, and L. R. Wilson, vice-president an eral manager of the Abitibi organization. Jean Rollan died and was succeeded as president of the paper co bearing the family name by Jean Pierre Rolland. Christie, founder and president of National Business lications Ltd. passed on, his successor being R. C. Rowe

1947

Production in 1947 hit $700,000,000 in value. New opening during the year included that of Bloedel, Stew Welch at Port Alberni for the manufacture of unbleache phate. Another new west coast mill was that of Sidney ing & Paper Co. at Victoria. Among other important ch and additions to mill equipment was the installation Yankee machine at Westminster Paper Co. Ltd. at New minster, B. C. A new sulphite plant and a new headi building were erected at the Ontario Paper Co. at Thorol Interlake Tissue Mills at Merritton, also in Ontario, a new groundwood department. Considerable improve were made at the Wayagamack mill of Consolidated Corp. Ltd. The long-awaited report of the Ontario Commission on Forestry made its appearance, prepare the supervision of Major General Howard Kennedy.

Staff changes during the year included S. L. de C stepping into the presidency of Canadian International Co., replacing John H. Hinman, and Richard Collins a president of Consolidated, in charge of production. Cadman retired from the permanent staff of the Can Pulp and Paper Association after 25 years of service a succeeded by F. L. Mitchell, formerly with the Abit ganization. Leander Manley received the appointm head up the permanent staff of the western branch Technical Section. Deaths during the year were Lt. Co Donohue at 70, George Carruthers at 78, and C. Ja

The KVP Co. at Espanola, Ont.

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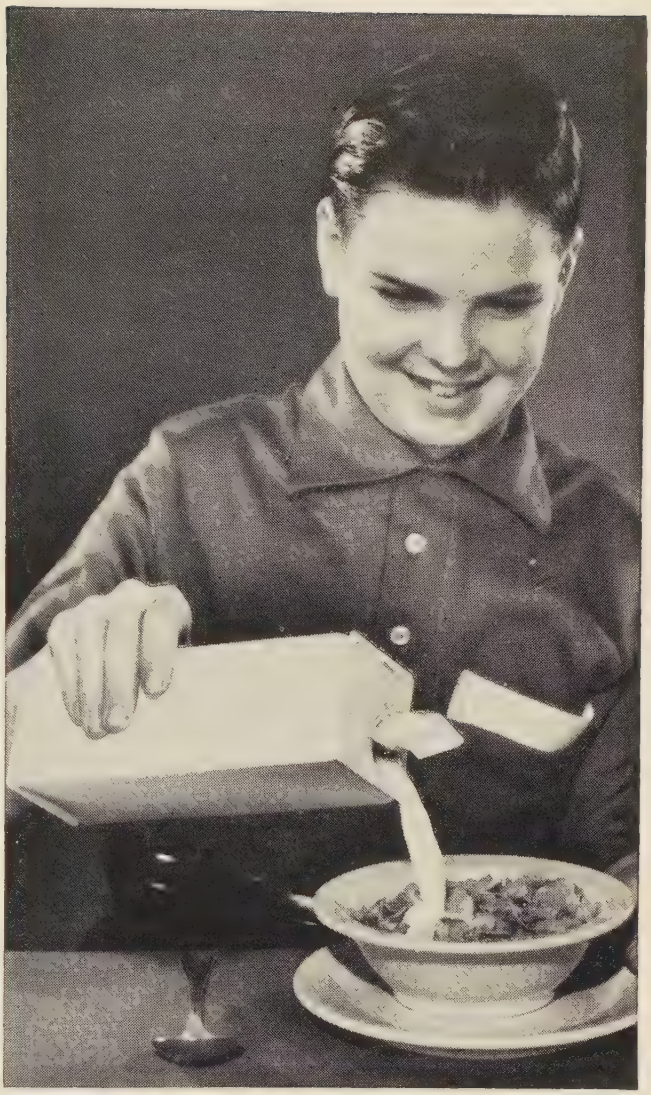

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Booth at 84. John S. Gibb, mill agent for the International Paper Co. and employed by it for 46 years, also passed away.

1948

New mills opening during 1948 included Long Lac's bleached sulphate mill at Terrace Bay, Ont., and Arborite Co. of Canada Ltd. at Ville La Salle, Montreal, which supplied a large quantity of its production to the newly opened Laurentian Hotel in Montreal, both for interior and exterior use. The Powell River Co. started its no. 8 machine. Considerable improvements were also completed at the Kenora and Fort Frances mills of Ontario Minnesota Pulp & Paper Co.

George M. Hobart became president of Consolidated Paper Corp., with L. J. Belnap moving into the chairmanship of the board of directors. G. Gordon Gale served a brief term as president of The E. B. Eddy Co., becoming vice-chairman of the board with W. G. Weston as chairman. W. S. Kidd was the new president and managing director of the Eddy Co. Louis W. Michael was elected president of Donnacona Paper Co. Ltd. and R. P. Kernan as board chairman. A. C. "Coosie" Price became president of the family firm, with G. F. Layne as vice-president and general manager. J. J. Herb celebrated his sixtieth year in the pulp and paper business. The Woodlands Section for the first time met at a different date from the Technical Section.

To the sorrow of all that knew him and the regret of many more that had not had that privilege, John Stadler died at the age of 74.

1949

Some interesting new developments marked the year 1949, one of them being the curlation process for the refining of sulphite pulp, developed almost fortuitously at the Riverbend mill of Price Brothers & Co. Ltd. Bathurst Power and Paper installed a new wood handling system, the central feature of which was a revolving table in the woodroom for routing the blocks. A Tomlinson caustic liquor recovery unit was installed at the Cornwall mill of Howard Smith Paper Mills Ltd. A neutral sulphite semichemical pulping plant was installed at the Abitibi mill at Sturgeon Falls, Ont. New installations during the year included the completion of the woodroom and groundwood mill at Abitibi's Iroquois Falls mill, the modernization of Donohue Brothers Ltd., the construction in British Columbia of the Nanaimo Sulphate Pulp Ltd., an H. R. MacMillan subsidiary, and of the Columbia Cellulose Co. mill. The entry of Newfoundland into the Dominion brought two large new mills into the Canadian picture, with Bowater's no. 7 machine at 284 in. wide geared for 2000 f.p.m. and an annual production of 100,000 tons. Statisticians had a field day with asterisks and footnotes saying either "includes Newfoundland" or "omits Newfound
when they were compiling their figures. Howard Smith
Mills Ltd. obtained control of Donnacona Paper Co., ar
city of Sherbrooke bought the idle Brompton mill at Bi
tonville, mainly for the waterpower rights on the St. F
River. *The Pulp and Paper Magazine of Canada* emerge
new format, with an improved type design, layout, and
The first world pulp conference was held in Montreal
the auspices of the FAO division of the United Na
Twenty-eight nations were represented.

A. P. Jewett became general manager of Provincial
Ltd., and A. Welch took over the same job at The E. B.
Co. T. E. Silver, manager of mills for Abitibi, and
Monty, manager of the Gatineau mill for International
during the year. Col. C. H. L. Jones, former preside
Price Brothers & Co. Ltd., and F. A. Sabbaton, preside
Dryden Paper Co. Ltd., also died. Ed. Calnan, tech
section councillor and steam plant superintendent fo
Ontario Paper-Quebec North Shore, was killed in the cra
a plane downed by a bomb on the way to Comeau Bay.

1950

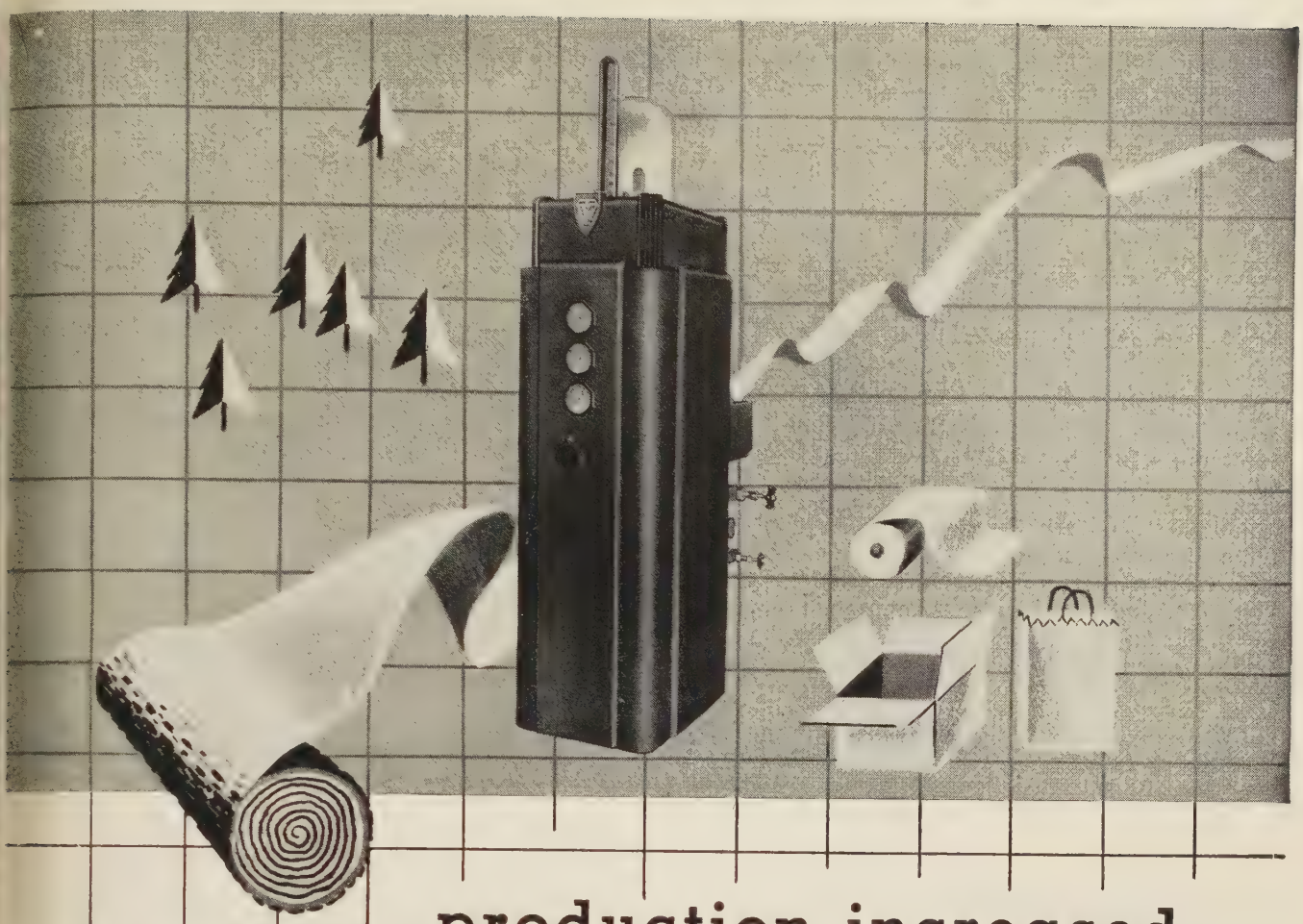
The use of radioactive iodine on some of the pulp i
screens at Comeau Bay, plus Geiger counters at the w
gave the mill a chance to trace the course and distribut
the pulp fibers and marked the first use of this type ob
identification in Canada. The Nanaimo Sulphate Pulp
which became the pulp division of H. R. MacMillan E
Ltd., went into production. The Elk Falls plant at D
Bay, B. C., was begun and the Ocean Falls division of H
Mills was modernized. In Quebec Province new
plants were opened at Brown Corp., at La Tuque and a
E. B. Eddy Co. in Hull, and Anglo-Canadian in Quebec
installed a cylinder board machine and new boilers. T
tensive improvements made at Great Lakes Paper Co.
were almost completed before the end of the year.

L. F. Whittemore, former president of the New York,
Haven, and Hartford Railway, became the chief execut
the Brown enterprises, and Major General Howard Ke
was named to head the United Nations agency for the
East. During the year Lorne Goodall was elected pre
and general manager of Dryden Pulp Co. Royal S. K
retired as secretary of the Newsprint Service Bureau aft
years with the organization.

1951

The industry definitely forged ahead in 1951, with the
duction of pulp and paper products hitting 9.6 million
$8^1/_2\%$ over 1950. Plants opening during the year inc
Anglo's Lignosol subsidiary for the utilization of wast

Sidney Roofing & Paper Co., Victoria, B. C.



production increased up to 15 tons per day...

. . . with W & T chlorination equipment

A Southern mill had been having trouble with paper breaks attributable to the presence of slime in their white water. Despite continued efforts to control them slime breaks were running 60 to 80 per week, resulting in a time loss of 10 to 14 hours per week, and an average production loss of 15 tons per day! It was then that the W&T man was called in. Where and how to apply the proper treatment was determined, the costly methods were discontinued, and W&T chlorination was installed.

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During the next 25 days there were no breaks attributable to slime!

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I-42

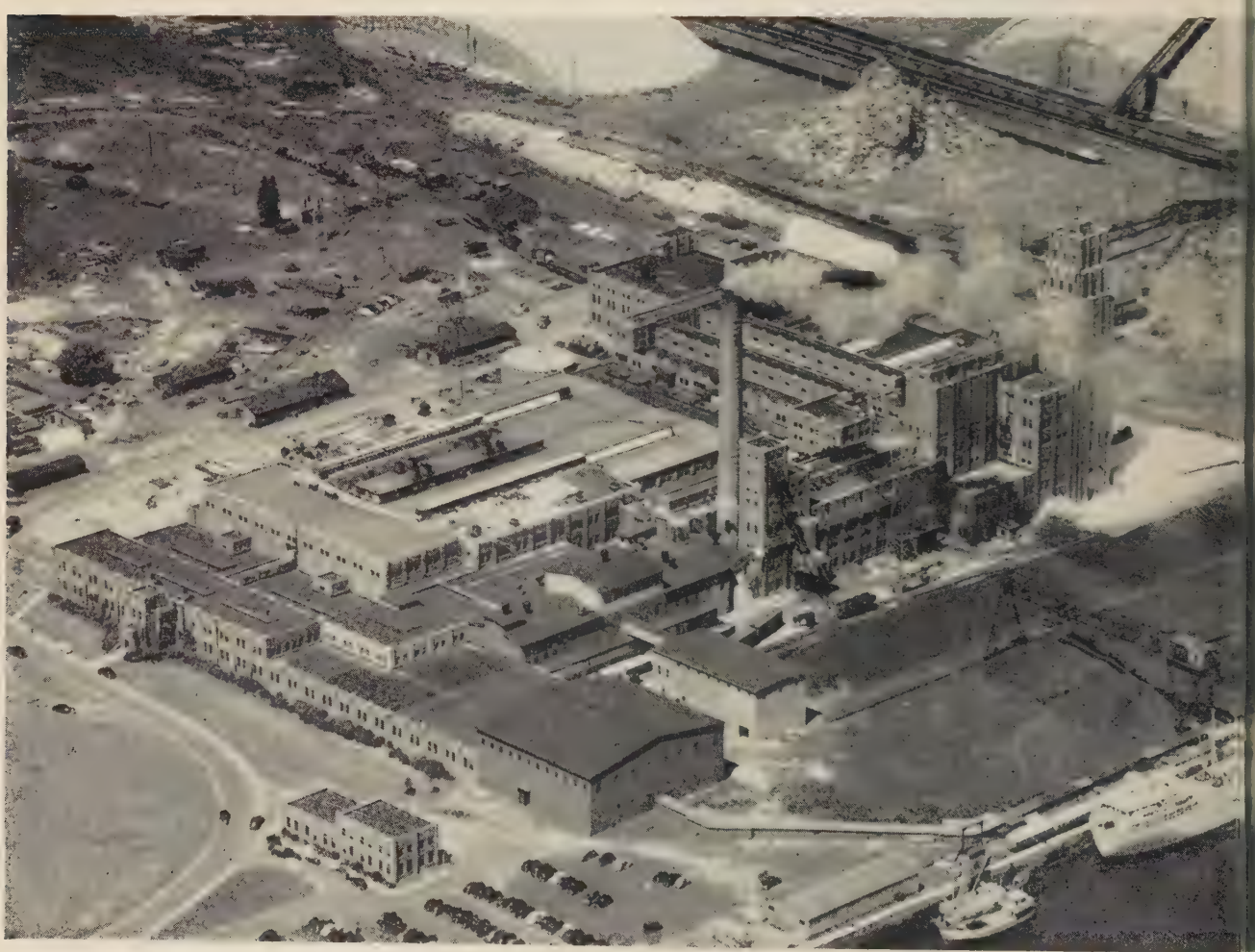
phite liquor, the mill making semichemical pulp from hardwood at Bathurst for the manufacture of corrugating board, and the Harmac bleach plant. Important changes in mill organizations were, among others, the acquisition of Sorg Pulp Co. at Port Mellon, B. C., by Canadian Forest Products Ltd. and the organization of Alaska Pine & Cellulose Ltd. with the planning of a $6,000,000 improvement program. Extensive alterations were also projected at Brown Corp., La Tuque, Que., and the two mills of the Ontario-Minnesota Pulp & Paper Co. Ltd. in western Ontario. The June issue of the magazine was devoted to the new Columbia Cellulose mill at Port Edward, B. C. The school of papermaking opened at Three Rivers, Que.

Articles on chemical debarking, the Haug Kollermill, the sulphur problem, the use of helicopters in fire fighting, and the use of bagasse for newsprint all showed the forward steps being taken on the technical side of the industry. The Canadian Pulp and Paper Association commissioned six prominent Canadian artists to paint six different types of Canadian forests, which were reproduced in full color in the magazine. An International Symposium on the Fundamental Chemistry of Cellulose and Lignin was held in Montreal in September. Princess Elizabeth and the Duke of Edinburgh visited the mill at Kapuskasing of the Spruce Falls Power & Paper Co.

Staff changes during the year involved R. R. Edwards as manager of Pacific Mills Ltd., at Ocean Falls, R. H. R. Young as vice-president of the same company, and G. W. McPherson and Warren Beckler, Jr. as vice-presidents of Alaska Pine and Brown Corp., respectively. Sidney E. Williams became general manager of St. Lawrence Paper Mills Ltd. on the death of A. George Jacques. Ben F. Avery became president of the KVP Co. Ltd. at Espanola, Ont., Ralph Johnstone became vice-president and general manager of St. Raymond Ltd., and A. Welch occupied the same post with The Eddy Co. W. H. Holland moved to the States as mana production of the Oxford Paper Co. at Rumford, Me. West and Kay Crabtree retired, the former from the ma ship of the Canadian International Paper Co. mill at Rivers and the latter from the Howard Smith mill at tree, Que. Deaths during the year included George Ch Jr. at 78 and J. D. Jenssen (of the acid towers), at Newell Stephenson, a TAPPI medal holder, present 1951 award to George H. Tomlinson, Sr.

1952

There were several outstanding news stories during one of which was the completion of the reorganization Pulp and Paper Research Institute of Canada, whic tinued to be a cooperative enterprise in which the Do Government, McGill University, and the Canadian Pu Paper Association took part, with Lincoln R. Thiesme president. The $500,000 spruce budworm spraying pro New Brunswick was carried out through the joint eff the New Brunswick International Paper Co. and the cial Government, and was so successful that a bigger a ter attack was projected for the following year. Th International Pulping Conference by the Technical S CPPA, was held at Murray Bay, Que. It attracted 17 gates including 53 from foreign countries. On the woo side the Bonnard prehauler was introduced to the in and mechanical hauling of pulpwood received considera tention at a panel discussion during the Woodlands S meeting. A lengthy article discussed the use of bagasse manufacture of newsprint, and it was actually printe



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Columbia Cellulose mill at Prince Rupert, B. C.

four-page insert of this type of paper, showing more vividly than mere words what use could be made of sugar cane waste.

Mill Changes

Mill changes and improvements projected included two plants at Castlegar, B. C., by the Celgar Development Co. Provincial Paper Ltd., planned on tripling its production, doubling its paper machine capacity, and adding 50% more employees. Bowater's Newfoundland Pulp & Paper Mills planned a $4,000,000 improvement program, and Westminster Paper Co. planned the erection of a $25,000,000 kraft mill on the West Coast. Irving Pulp Co. in New Brunswick allocated $20,000,000 for improvements, but received a temporary setback when the chiploft was burned. Production of 200 tons of bleached sulphite and 250 tons of bleached kraft was expected from the finished plant.

Personnel

Personality items noted durin course of preparing these notes the 71st anniversary of Joh Taylor's employment by The Eddy Co., the election of Ellio Little as a life member of the Te cal Section, CPPA, and C Vining's resignation from the print Association of Canada aft years. Personnel changes inc among others, the move of "Jeep" Neal from Anglo-Can to the Anglo-Newfoundland Dev ment Co. mill as manager. Ch in Price Brothers were the retire of G. F. Layne, the appointm of Hector Cimon and Joseph Ed as vice-presidents, and that of Surveyor as secretary. At St. Lawrence Corp. J. J. R. retired and was succeeded as president by P. M. M. W. McCutcheon became chairman of the board S. E. Williams vice-president and general manager. Wilson was made vice-president in charge of kraft and production and J. W. Fries vice-president in charge of lands. L. F. Winchell was chosen as president of & Dauch's Canadian operations, and E. Norval H became president of Appleford Paper Products Co. and president in charge of all Canadian operations of the Co. Ltd. W. S. Kidd retired from the presidency of T B. Eddy Co., being succeeded by R. A. Robertson, dent and general manager of the parent company, G Weston Ltd. A. J. Philip became assistant general mana Canada Paper Co. being replaced as mill manager by Rice and W. E. Soles became general manager of Ang

***Early view of Garden City Press, Gardenvale, Que., publisher of the* Pulp and Paper Magazine of Canada**

Construction was actually started, during the year, on the Canadian Glassine Co. plant beside the Anglo-Canadian mill in Quebec City. At Cornwall Howard Smith started up the new no. 1 paper machine and the new steam plant. The KVP Co. produced the first vegetable parchment at its Espanola, Ont., mill. The Gatineau mill of the Canadian International Paper Co. began using its new set of self-sluicing blowpits, another step on the way from a batch process to a continuous one for the production of paper. The September number of the magazine was devoted to the newly opened Elk Falls mill in British Columbia, with about 80 pages of stories and pictures covering the complete mill and woods operations. This is the only new newsprint mill to be started up in over 20 years.

nadian. Clifford Crispin was promoted to vice-presid the pulp division of MacMillan & Bloedel Ltd. Death ing the year deprived the industry of Frank Sensenbren the age of 87, who had put in 63 years with the Kim Clark interests and who finished as president and chairm the board of directors. J. Pierre Rolland also died an succeeded as president by Lucien Rolland, who had named vice-president and general manager earlier in the Marc Rolland became vice-president and mills manage Roy H. Ecclestone vice-president and sales director.

According to the Newsprint Association of Canada, pr tion in 1952 was 5,687,051 tons, an increase of 171,00 over 1951.

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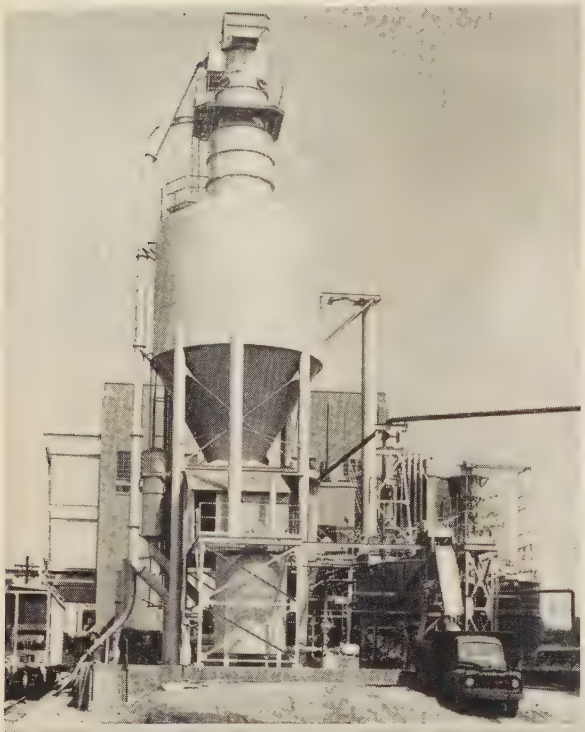

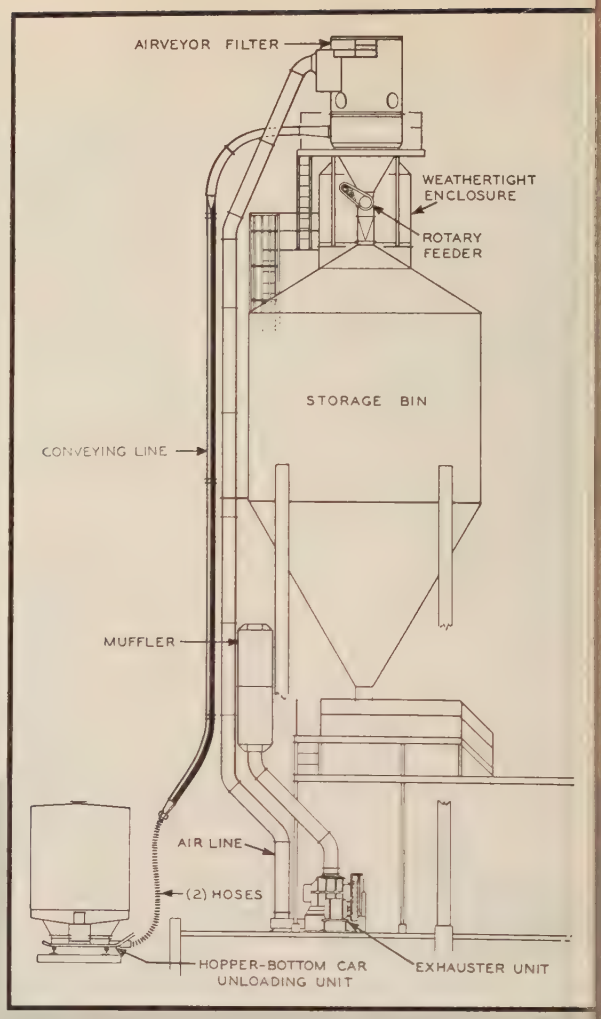

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The paper industry has learned by experience that the Airveyor is engineered and built for superior performance . . . well over a hundred systems have been installed in various mills in the United States and Canada.

If you have a problem in your handling of mill-supply chemicals why not let us make a study of your layout . . . chances are we may be able to show you a more efficient and profitable method of operation . . . such a study costs you nothing, obligates you in no way.

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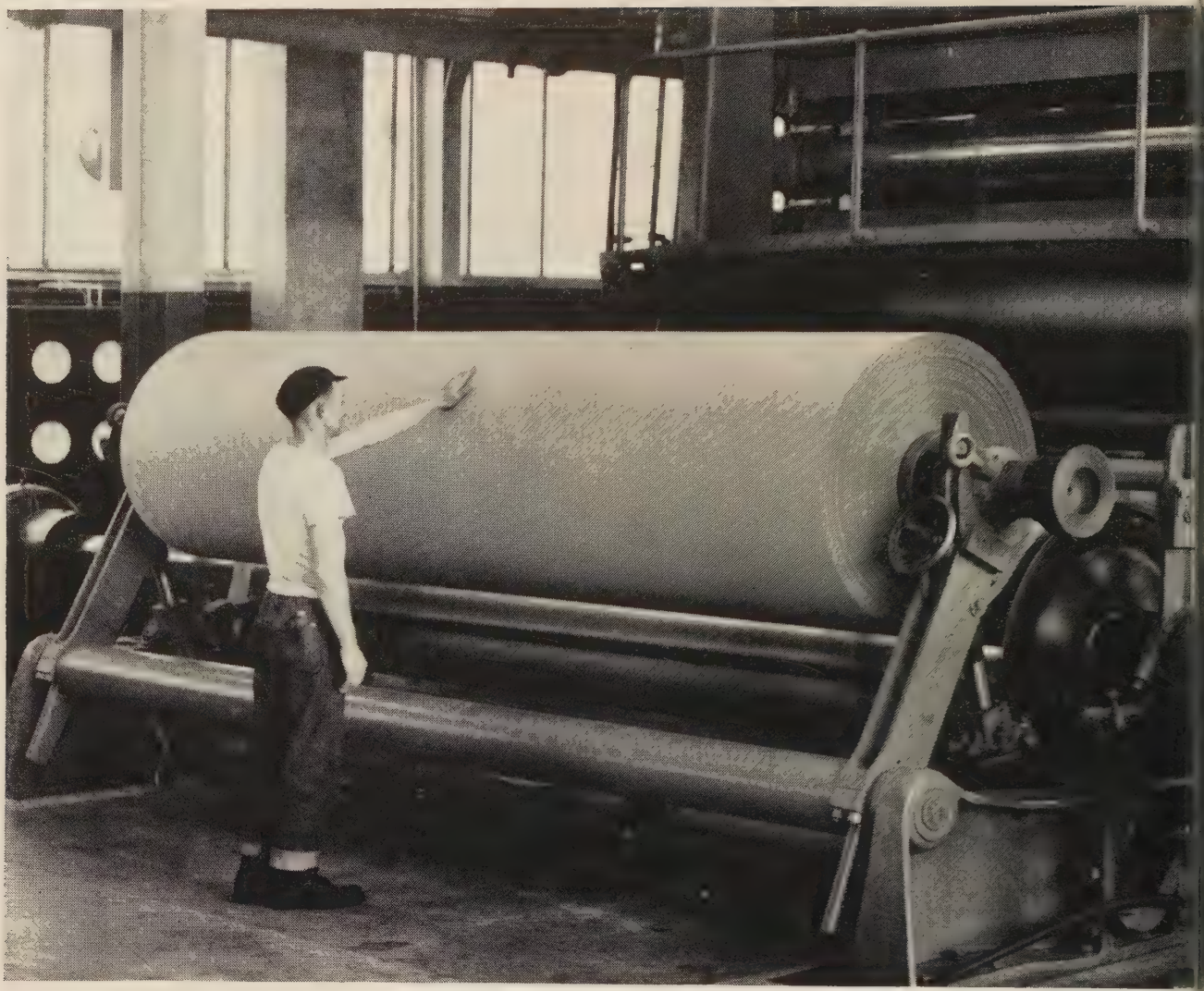

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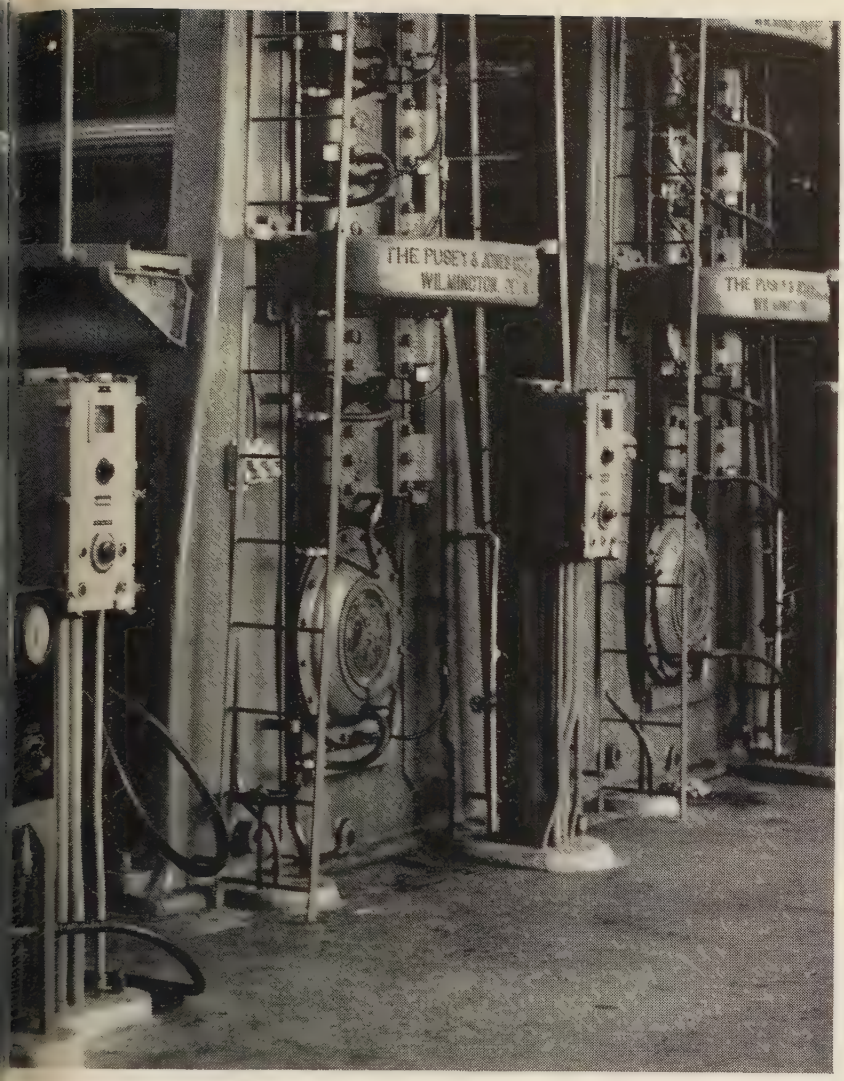

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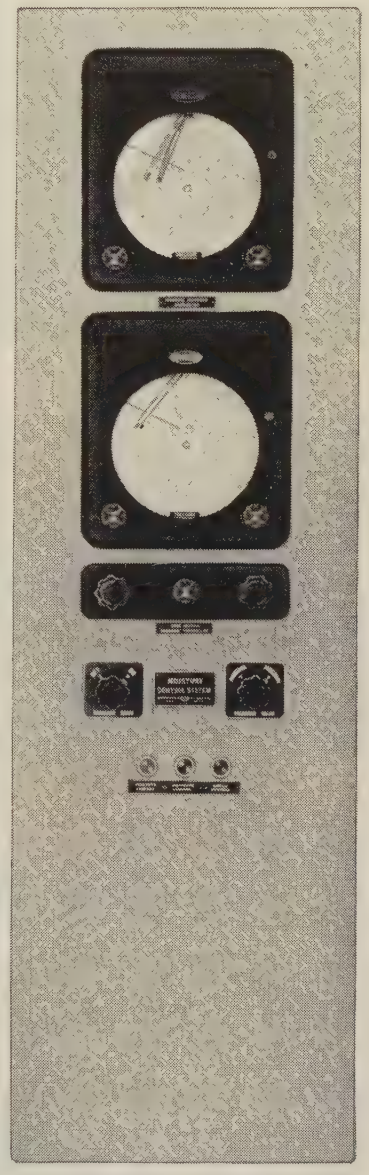

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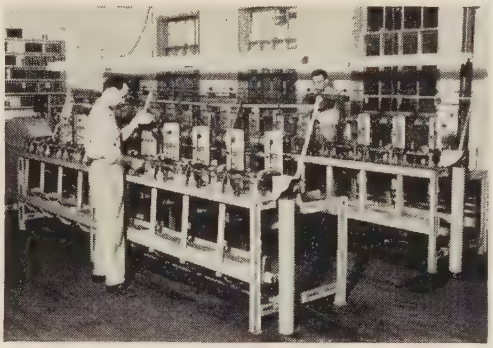
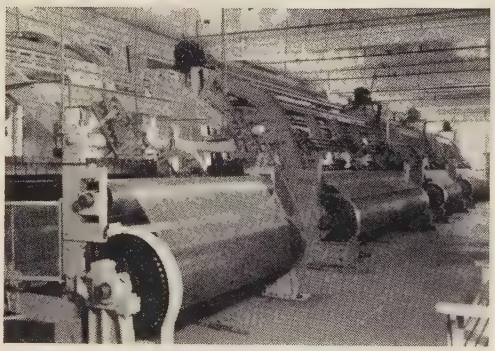
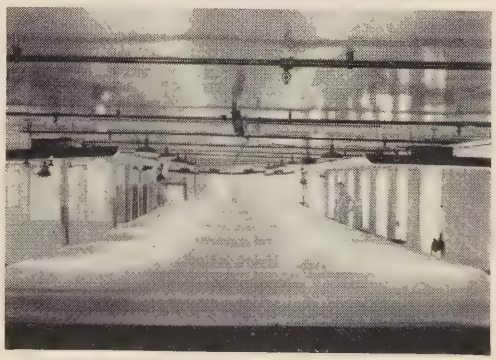


1. Corner winding dep't.



2. View showing looms in one corner of weaving dep't.



3. Stretching and inspecting completed wire.

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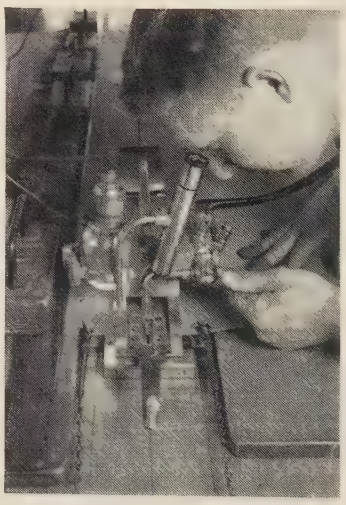
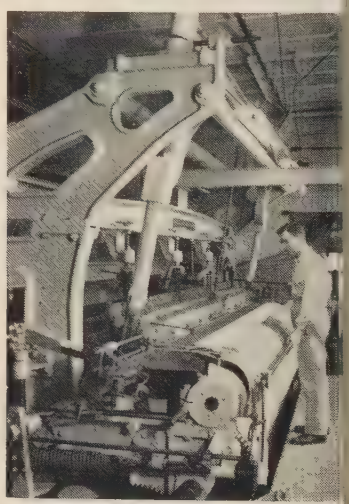


4. Showing seaming of Wisco fourdrinier wire.



5. Modern power loom being operated by skilled wire weav

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DATA FROM GOULD PAPER COMPANY

Pulp	Tons/day	Before bleach	After bleach	Brightness increase
Sulfite*	50	55-59	73-75	18-20
For Sulfite and Groundwood-Sulfite*	130	57-59	68-70	11
For Groundwood**	100	58-60	68-70	10

Consistency 12-15% *2% sodium peroxide
**1.8% sodium peroxide

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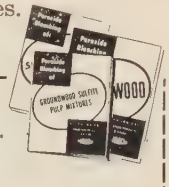

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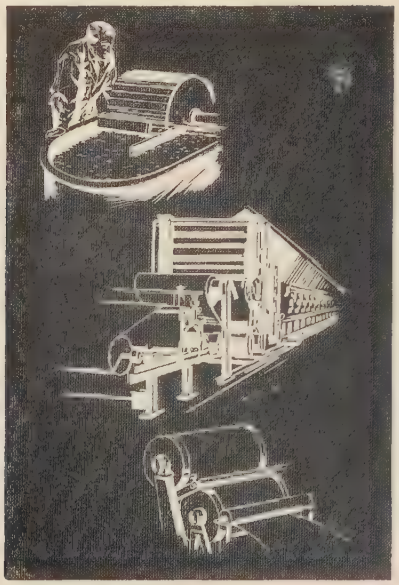

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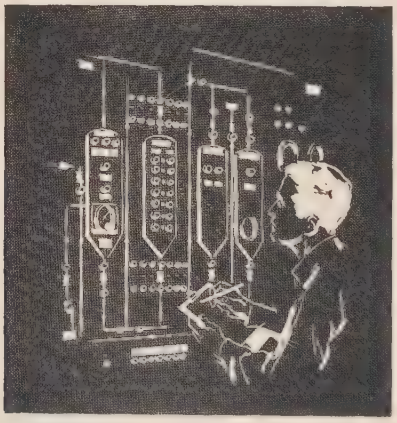

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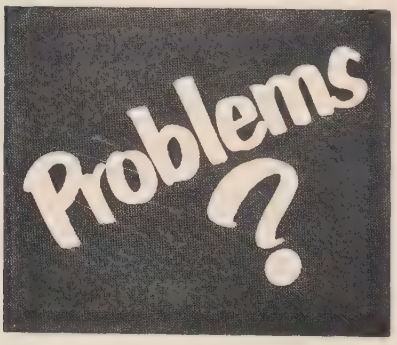

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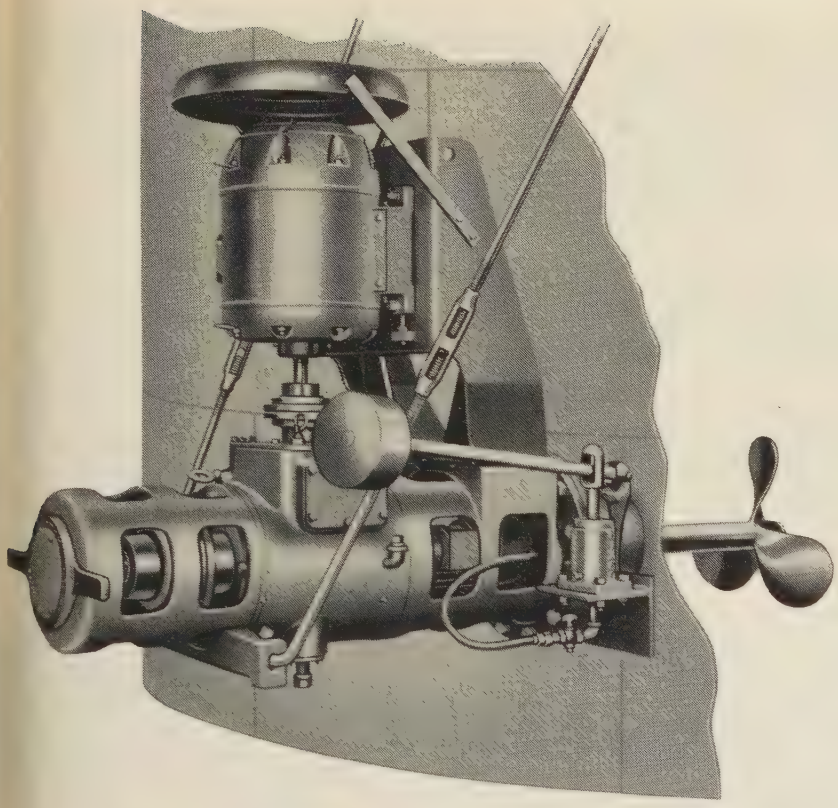

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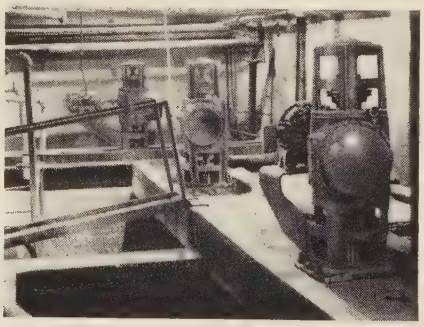

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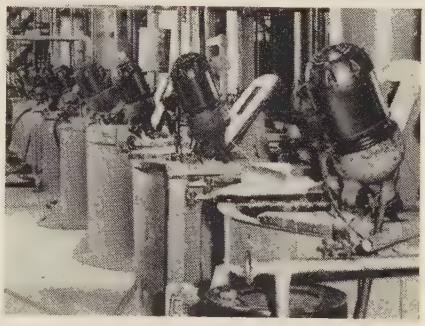

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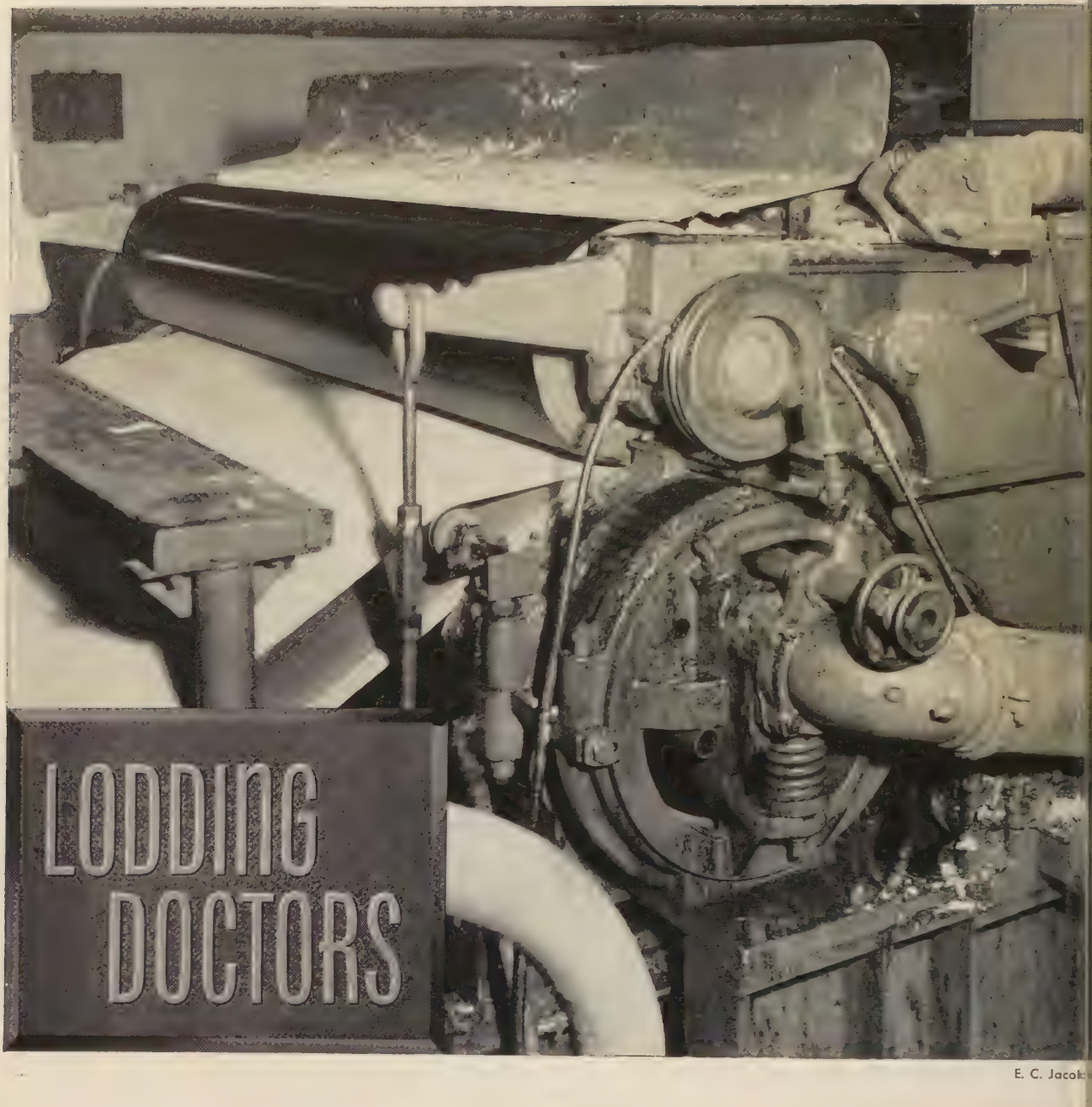

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Mannan in Purified Wood Pulp and Its Relation to Cellulose Acetate Properties

H. W. STEINMANN and B. B. WHITE

An attempt has been made to determine the causes of the extremely high viscosities obtained in concentrated acetone solutions, using cellulose acetates prepared from varying samples of purified wood pulp. It was postulated that this behavior could be associated with the hemicellulose content of the wood pulps, specifically with their mannan content. An effort was therefore made to characterize the pulps by means of the rate of reaction with lead tetra-acetate in acetic acid solution since this is believed to be primarily a reaction with mannan in the initial stages. A good correlation of the lead tetra-acetate consumption of wood pulps, as obtained by the extrapolation of the rate curves, was found to exist with the viscosity ratio of the cellulose acetates prepared from them. A correlation with pentosan content was also obtained. However, analysis of the hydrolyzate from the cellulose acetate itself showed the mannan content of the acetate to correlate with viscosity ratio while the pentosan content did not. Presumably more pentosans than mannans are removed during the acetylation process. Using the Ohlsson method of analysis to determine the amount of gamma fraction in the wood pulp, a good correlation was obtained between the gamma content and the mannan content of the pulps and, also, between gamma content and viscosity ratio of the corresponding cellulose acetate. While the evidence leads to the conclusion that mannan in wood pulp is the principal source of anomalous viscosity behavior of cellulose acetate prepared from it, the fundamental basis for this relationship has not been explained.

THE specifications for purified cellulose to be used in the manufacture of cellulose acetate for textile yarns are largely determined by the end-use requirements. Although it is generally conceded that only high alpha-cellulose is suitable for this application, other requisites must also be considered. The cellulose must be reactive, it must give an acetate of acceptable color and the cellulose acetate prepared from it must exhibit the desired rheological properties.

In spinning cellulose acetate from acetone solutions it is necessary to maintain the viscosity of the spinning solution constant in order to control the yarn quality. The variability of the viscosity is dependent on concentration, which can be rigidly controlled, and on the uniformity of the acetate used. Assuming a product of constant degree of substitution, the viscosity of solutions of cellulose acetate should be related to molecular weight which can be readily approximated by determination of the relative viscosity of dilute solution of the acetate in a solvent such as acetone from which intrinsic viscosity may be calculated by the use of any of a number of suitable equations.

In actual plant practice intrinsic viscosity measurements are rarely used. It is customary instead to measure the viscosity of a more concentrated solution; for instance, a 7% solution of cellulose acetate in acetone is prepared and the viscosity in centipoises is obtained by measurement of flow time in a properly calibrated Ostwald viscometer. Such measurements have been shown to correlate well with intrinsic viscosity and viscosity at spinning concentrations, measured by the ball-fall method, when the cellulose acetates are of known and similar history.

It is well recognized that cellulose acetates prepared from wood pulp exhibit anomalously high viscosities at high concentration when compared to those of identical intrinsic viscosity prepared from cotton linters. Recently wood pulps were tested in our laboratories which showed very exaggerated high viscosities at high concentrations. Since the behavior varied from sample to sample it was found necessary to develop some quantitative expression which described this behavior.

A method for comparing the viscosity characteristics of various cellulose acetate samples at a constant intrinsic viscosity or molecular weight is demonstrated in Fig. 1. It has been shown previously that a plot of log viscosity versus concentration over the range 5 to 30%, gives an approximate straight line for any given cellulose acetate. If one assumes this straight line relationship valid and plots the log of viscosity at 27% concentration for several cellulose acetates prepared from different celluloses and having the same viscosity at 7% concentration, a series of curves are obtained as shown in Fig. 1. The relative slopes of these lines can be expressed by the relationship 27%/7% and this value times 10^{-2} has been designated as the "viscosity ratio." In actual practice in determining the viscosity ratio for various cellulose acetates which do not have the same molecular weight and therefore the same viscosity at 7% concentration, a known correction factor can be applied. Also, if necessary, the measured viscosity ratio can be corrected to a constant acetyl value so that comparisons of the final viscosity ratio of the samples can be made at a constant molecular weight and acetyl value.

Malm, Tanghe, and Smith (*1*), Lohmann (*2*), and others, have attributed the anomalous viscosity of wood pulp acetate in highly concentrated solutions to high carboxyl content and subsequent cross linking through the formation of salts with bivalent cations such as calcium or magnesium. However, analysis of a series of wood pulp samples which gave cellulose acetates having high viscosity ratios shows that the carboxyl content measured on the electrodialyzed pulps by a calcium acetate titration method patterned on that of Yackel and Kenyon (*3*) was fairly constant as shown in Table I. Moreover, leaching treatments, usually successful in breaking cross links of the type suggested, and thus

H. W. STEINMANN and B. B. WHITE, Summit Research Laboratories, Celanese Corp. of America, Summit, N. J.

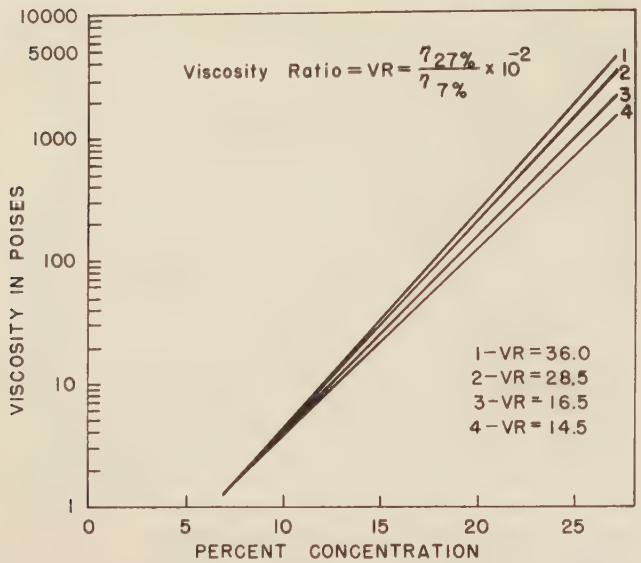

Fig. 1. Viscosity concentration relationship for cellulose acetate prepared from different celluloses

reducing the viscosity, had little or no effect on the viscosity of these acetates.

MANNAN CONTENT OF PULPS VERSUS VISCOSITY RATIO

Since some earlier unpublished work in our laboratories which had been concerned with pulps of low alpha content had indicated a possible relationship between "viscosity ratio," as defined here, and mannan content of the pulp, it seemed plausible that the hemicelluloses, and specifically the mannan content, of the cellulose might be responsible for this behavior. An attempt was made, therefore, to find some relatively simple and rapid method for estimating the mannan content of the pulp.

Criegee (*4*), Price, and collaborators (*5*) and Hockett, Dienes, and Ramsden (*6*) have demonstrated that lead tetra-acetate in glacial acetic acid solution oxidizes glycols to pairs of carbonyl groups at rates that are greater for cis than trans isomers and are dependent upon the particular glycol examined. It was postulated that this rate difference might be useful in distinguishing between the cis-glycol groupings in the 2–3 position in mannan and the trans glycol in cellulose. If the differences in rate of reaction of these two isomeric groupings were sufficiently great, samples of cellulose containing high percentages of mannan might show an initial rapid reaction with lead tetra-acetate which would taper off as the mannan was oxidized and the cellulose reaction became predominant; on the other hand, those containing little or no mannan would show a slow i reaction without much change in rate with incr reaction time. Such rate studies it was hoped mig utilized to give an indication of mannan conte pulps.

Table I. Carboxyl Content of Wood Pulp and Viscosity Ratio of Corresponding Cellulose Acetate

Sample	*Carboxyl content of pulp, m.e./100 g. cellulose*	*Viscosity ratio of corresponding cellulose acetates*
1 (cotton linters)	1.30	11.4
2	2.20	16.6
3	2.32	17.2
4	1.90	19.4
5	2.40	26.2
6	2.02	28.1
7	2.04	30.1
8	1.92	38.2
9	1.90	44.4
10	1.90	46.0

The procedure used for determination of lead acetate consumption differed from that of other in gators in that the reaction was necessarily carried a heterogeneous system. It was as follows: Samp bleached wood pulp were dried at 106°C. for 4 hr noncirculating air oven. Approximately 0.01 mol dry pulp was charged into a two-necked 300-ml. equipped with a mercury-sealed stirrer. Exactl ml. of purified glacial acetic acid (purified by refl with chromic anhydride and distilling under rec pressure) were added. The mixture was stirred hr. in a water bath maintained at 30 ± 0.1°C. E 25 ml. of an approximately decinormal solution o tetra-acetate in glacial acetic acid were then adde mixture being maintained at a temperature of Ten-milliliter samples were pipeted out at 15-mi tervals, discharged into 20 ml. of a potassium io sodium acetate solution and titrated with 0.01 *N* sc thiosulphate solution using starch as the indicat blank consisting of 100 ml. of purified glacial aceti and 25 ml. of the same lead tetra-acetate solutio prepared and sampled and titrated as above. Th ference in volume of sodium thiosulphate solutio quired for the blank and the pulp solution is equiv to the lead tetra-acetate consumed.

The mols of lead tetra-acetate consumed per m pulp at a given time t in minutes, can be calculat the following equation:

$$y = x + \frac{8.1 \times 10^{-5}}{w}(a)(b)$$

where

y = mols. of lead tetra-acetate consumed per mol. of p min.
x = mols. of lead tetra-acetate consumed per mol. in $t - 15$ min.
a = milliliter difference in volume of Na_2SO_3 solution re for $t - 15$ and t min., respectively
b = milliliter volume of solution in flask during 15-m terval being measured
w = weight of sample of pulp in grams

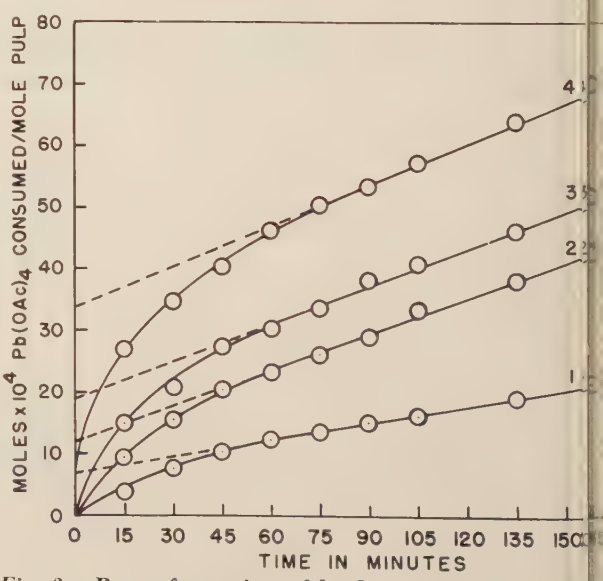

Fig. 2. Rate of reaction of lead tetra-acetate with pulp and cotton linters

Table II. Rate of Reaction of Lead Tetra-acetate with Wood Pulp and Cotton Linters Samples

Sample no.	Weight of sample, g.	Difference between blank and sample in ml. 0.01 N $Na_2S_2O_3$ and calculated mols. × 10^4 $Pb(OAc)_4$/mol. pulp at time t, min.								
		15	30	45	60	75	90	105	135	165
1 (cotton linters)	1.6853	0.07	0.14	0.19	0.23	0.26	0.30	0.33	0.44	0.54
		4.0	7.9	10.4	12.3	13.8	15.3	16.1	19.2	21.4
2	1.6496	0.16	0.26	0.35	0.42	0.49	0.57	0.70	0.88	1.08
		9.6	15.8	20.4	23.2	26.2	29.1	33.5	38.4	42.9
3	1.6322	0.24	0.34	0.47	0.53	0.61	0.73	0.81	1.03	1.25
		15.0	20.8	27.4	30.3	33.7	38.2	41.0	46.5	52.1
4	1.6211	0.43	0.56	0.67	0.79	0.89	0.97	1.09	1.31	1.54
		26.9	34.7	40.6	46.3	50.5	53.4	57.4	64.1	70.0

Data on the rate of consumption of lead tetra-acetate for a series of celluloses are given in Table II. Plots of these data, shown in Fig. 2, indicate an initial rapid reaction which approaches a linear rate after about the first hour. If the break of the curve marks the end of the reaction with the cis-glycol group of mannan and the subsequent slower reaction is that of the trans hydroxyl of cellulose, extrapolation of the straight line portion to zero time should give an estimate of the relative mannan contents of the various celluloses. It will be noted that curve no. 1, which is cotton linters, shows a low consumption of lead tetra-acetate as compared to curve no. 4, which represents a wood pulp. The cellulose acetate prepared from the wood pulp represented in curve no. 4 had an unusually high viscosity ratio (59.7) as compared to that from cotton linters (11.5).

Curves of the type illustrated in Fig. 2 have been obtained on 16 cellulose samples from which cellulose acetates of standard acetyl value and viscosity have been prepared. Viscosity ratios were determined on these acetates by the procedure described earlier. These data are recorded in Table III; the lead tetra-acetate values are plotted against the log of the viscosity ratio in Fig. 3. It will be noted that the correlation between lead tetra-acetate consumption of the pulp and log of viscosity ratio of the cellulose acetates prepared from them is excellent. A calculation of the correlation coefficient of the regression line gives a value of 0.93 which is significant at the 1% level.

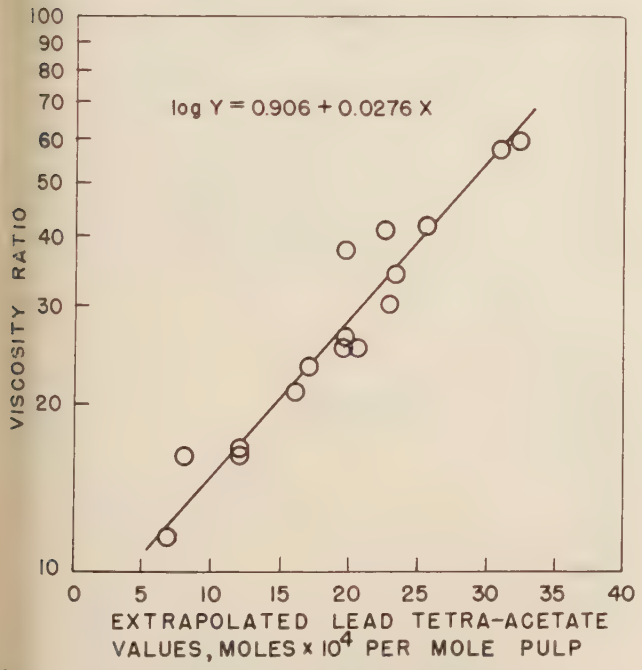

Fig. 3. Relationship between the extrapolated values of lead tetra-acetate consumption for wood pulps and viscosity ratios of corresponding cellulose acetates

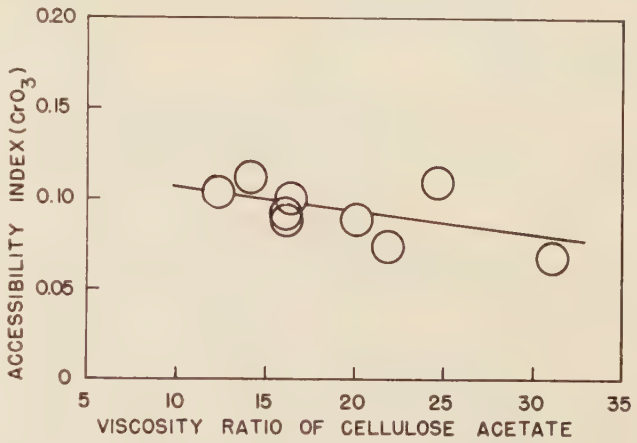

Fig. 4. Relationship between the accessibility of wood pulp as measured with chromic anhydride and viscosity ratio of the corresponding cellulose acetate

While the linear relationship between log of viscosity ratio of wood pulp and lead tetra-acetate consumption of the pulp appeared well established, it was believed that the accessibility and moisture content of the cellulose might have affected the consumption of lead tetra-acetate. However, studies carried out in our laboratories, independently of this work, demonstrated that the accessibility index, as determined by the reaction of cellulose with chromic anhydride in acetic acid medium, varied for this group of samples in inverse relationship with the viscosity ratio (as shown in Fig. 4). Since the relationship of lead tetra-acetate consumption and viscosity ratio is a direct one, it was felt that the differences

Table III. Relationship Between the Extrapolated Lead Tetra-acetate Values for the Wood Pulp Samples and the Viscosity Ratios of the Corresponding Cellulose Acetates

Sample no.	Moisture content of wood pulp, %	Extrapolated $Pb(OAc)_4$ values, mols. × 10^4/mol. pulp	Viscosity ratios of corresponding cellulose acetates
1 (cotton linters)	0.69	6.8	11.5
2	..	8.0	16.1
3	0.83	12.0	16.1
4	2.38	12.0	16.6
5	0.72	16.0	20.9
6	1.48	17.0	23.3
7	..	19.5	25.1
8	0.99	20.5	25.1
9	1.12	19.5	26.2
10	1.52	22.8	30.1
11	2.14	23.0	34.2
12	2.70	19.5	37.8
13	2.97	22.5	41.0
14	0.93	25.5	44.9
15	1.19	30.8	57.8
16	3.39	32.2	59.7

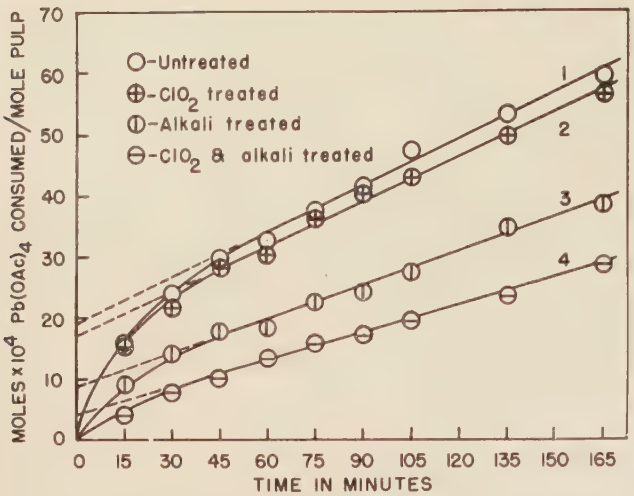

Fig. 5. Effect of chlorine dioxide and alkali treatments on the lead tetra-acetate consumption of wood pulp

in reactivity of the various wood pulp samples with this reagent could not readily be attributed to varying accessibility alone.

Lead tetra-acetate reacts with water and, therefore, it seemed expedient to dry the cellulose samples prior to carrying out the lead tetra-acetate reaction. A temperature of 106°C. for 4 hr. was considered ample although the final moisture contents varied more widely than anticipated, as shown in Table III. However, if moisture content and lead tetra-acetate consumption data are plotted, no correlation results. It was found in later experiments that cellulose samples dried under extreme conditions (that is, over phosphorus pentoxide at 80°C. under 2 mm. of mercury) gave only slightly lower values for lead tetra-acetate consumption than those dried under more moderate conditions, and it was concluded that the variations in moisture content recorded in Table III had, therefore, no bearing on the findings reported above.

Further confirmation of the relationship of lead tetra-acetate consumption to the hemicellulose content and, more probably, to the mannan content of wood pulp, was obtained in another series of experiments. The original pulp used in these experiments showed a lead tetra-acetate consumption of 18.5×10^{-4} mols. per mol. and a viscosity ratio of 46.0. This pulp was bleached with chlorine dioxide after which the lead tetra-acetate consumption remained substantially unchanged, as shown in Fig. 5. However, chlorine dioxide bleaching followed by treatment with 7% caustic soda resulted in a pulp (no. 4) on which lead tetra-acetate consumption was reduced to 4×10^{-4} mols. per mol. Treatment with 7% caustic soda, with no chlorine dioxide bleach, gave pulp no. 3 with a lead tetra-acetate consumption of 9×10^{-4} mols. per mol. This pulp gave a cellulose acetate with a viscosity ratio of 18.

Exact procedures for the treatment of these pulps were as follows:

Chlorine dioxide was prepared by heating a mixture of potassium chlorate, oxalic acid, and sulphuric acid. The concentration of the solution obtained was 7.7%.

To a 2-liter flask equipped with stirrer, there were added 30 grams of bleached sulphite wood pulp and 1 liter of the above chlorine dioxide solution. A buffer consisting of 60.5 ml. glacial acetic acid and 49.2 grams of sodium acetate was added which raised the pH from 3.2 to 4.3. The well-stirred suspension was heated to 65°C. and maintained at this temperature for 2. The suspension was cooled, filtered through a stainless washing can, and the pulp washed thoroughly with distilled The pulp was divided into two parts; one part was dried at temperature and then shredded in a small Waring Blendor the other was given a caustic treatment as follows:

A three-necked flask equipped with stirrer, nitrogen cap and thermometer was charged with 15 grams of the chlori oxide treated pulp, still wet with water. The flask was fl with nitrogen and 500 ml. of an 8% cold caustic solution (the wet pulp decreased the caustic concentration from 8 to The well-stirred suspension was cooled to 0 to 2°C. and s for 1 hr. A continual stream of nitrogen bubbling throu suspension was maintained. The suspension was filter quickly as possible through a Buchner funnel, and the re swollen pulp was washed successively with 500 ml. of 3% N 500 ml. of 1% NaOH, and finally with distilled water un phenolphthalein test was negative. The squeezed pul dried at room temperature and then shredded in a V Blendor.

DIRECT DETERMINATION OF MANNAN IN W PULP

While all these results point to mannan as a fact viscosity ratio it was deemed desirable at this poi isolate and identify mannan as a constituent of the pulps and to determine quantitatively the an present in pulps from which cellulose acetates of w varying viscosity ratio had been prepared.

The method of Hagglund and co-workers (*7*) as m fied by Roudier and Eberhard (*8*) has been used fo purpose.

A weight of 5 grams of wood pulp was treated wi ml. of 72% H_2SO_4 for 4 hr. at room temperature, occasional shaking. The solution was diluted to 3 H_2SO_4 acid concentration by adding 1600 ml. o tilled water and then refluxed for 7 hr.

The solution was neutralized by adding 220 gra barium carbonate and warming to about 40°C steam bath. It was filtered and the filtrate adjust a pH of 4.5 by dropwise addition of 1 *N* H_2SO_4 solution was refiltered through a Buchner funne Whatman no. 42 filter paper and a thin mat of asb The filtrate was concentrated to a volume of abo ml. by distilling under *vacuo* using a constant tem ture bath at 40°C. The residual sugar solution transferred to a glass-stoppered Erlenmeyer flask adjusted to a volume of 47 ml. by rinsings from th tillation flask. Then, 1.0000 gram of mannose booster charge was dissolved in the sugar solutio lowed by the addition of a solution of 5 ml. of pu phenylhydrazine in 5 ml. of 50% acetic acid and 4

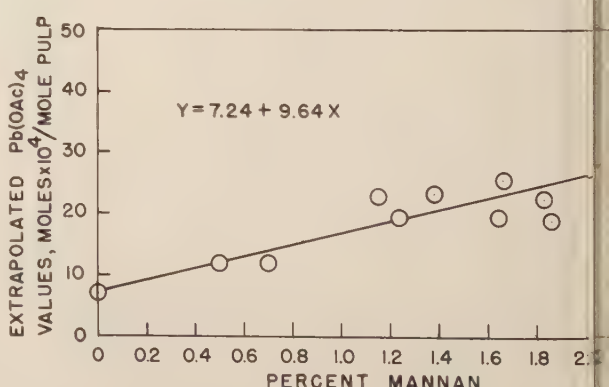

Fig. 6. Relationship between the lead tetra-ac consumption and mannan content of the wood p

Table IV. Comparison of Wood Pulp Analyses and Viscosity Ratios of Corresponding Cellulose Acetates

Sample no.	Viscosity ratios of cellulose acetates	Mannan content, %	Xylan content, %	Gamma content, %	Beta content, %
1 (cotton linters)	11.4	0	0.50	0.8	0.06
2	16.1	0.70	1.02	2.5	0.4
3	16.6	0.50	0.60	2.1	0.2
4	17.2	0.78	0.73	2.6	0.1
5	19.4	0.92	0.91	2.8	0.1
6	26.2	1.24	1.13	3.6	0.6
7	28.1	1.75	1.44	4.5	0.4
8	30.1	1.15	1.32	4.0	0.5
9	38.2	1.64	1.40	3.7	0.7
10	44.4	1.38	1.25	4.5	0.8
11	44.4	1.66	1.31	5.0	0.6
12	45.3	1.83	1.33	4.9	0.04
13	46.0	1.86	1.51	4.9	0.3
14	59.7	2.10	1.58	4.8	0.6

of absolute alcohol. This solution was permitted to stand for 48 hr. at 10°C.

A control sample, using cotton linters, was run simultaneously in exactly the same manner as described above. The mannose phenylhydrazone precipitated from both wood pulp and cotton linters hydrolyzates was filtered onto tared sintered glass filters and washed with 75 ml. of 95% ethanol saturated with mannose phenylhydrazone, then with 10 ml. of ice water, and finally with 30 ml. of ethanol, saturated with mannose phenylhydrazone. The precipitate was dried to constant weight over phosphorus pentoxide in a vacuum desiccator. The per cent mannan in the wood pulp was calculated by the following equation:

$$\text{Per cent mannan} = 0.6\,\frac{(a)}{b}(w_1 - w_2)\frac{(100)}{m}$$

where

w_1 and w_2 = grams of mannose phenylhydrazone from pulp and control samples, respectively

a and b = volumes of the filtrate of wood pulp sample before and after the first filtration of barium sulphate, respectively

m = weight of sample in grams

Mannan determinations were obtained on a series of pulps of known lead tetra-acetate consumption. Cellulose acetates had also been prepared from all these

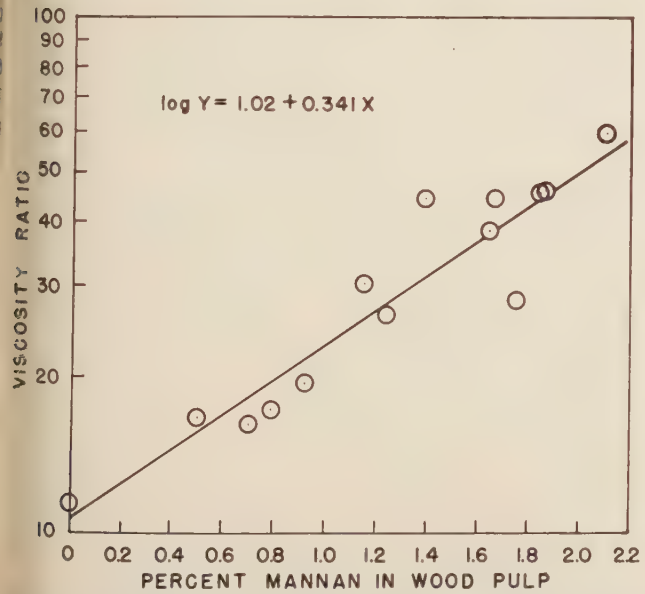

Fig. 7. Relationship between the mannan content of the wood pulp and the viscosity ratio of the corresponding cellulose acetate

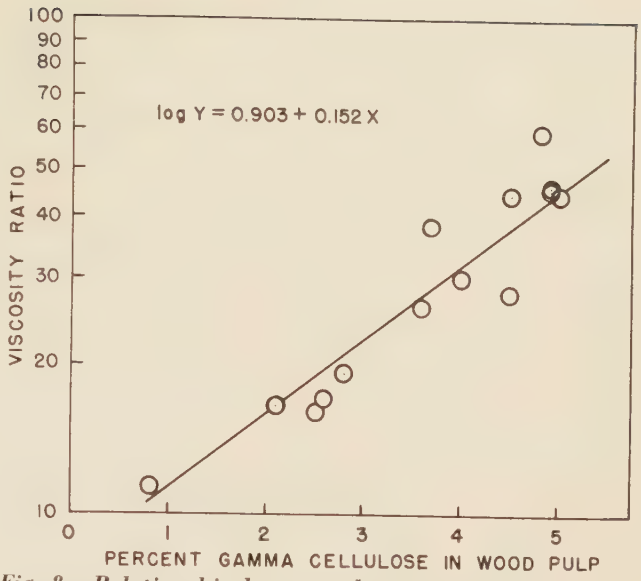

Fig. 8. Relationship between the gamma-cellulose content of wood pulp and the viscosity ratio of the corresponding cellulose acetate

pulps and their viscosity ratios determined. It was, therefore, possible to relate the per cent of mannan in the pulp to either the lead tetra-acetate consumption of the pulp or the viscosity ratio of the cellulose acetate. The relationships of mannan to lead tetra-acetate consumption and to viscosity ratio are shown in Figs. 6 and 7, where correlation coefficients of 0.86 and 0.93, respectively, have been obtained.

GAMMA-CELLULOSE CONTENT OF THE PULPS AND VISCOSITY RATIO

During this investigation, attention was directed to the work of Rånby (*9*), Wilson, Ringstrom, and Hedlund (*10*), and Ohlsson (*11*). Rånby had concluded, as a result of x-ray studies, that alpha and beta-cellulose have the same crystalline lattice, that of cellulose II. From electron microscopic studies he, along with others, postulated that beta-cellulose consists of disordered and broken micelle strings containing only depolymerized cellulose. The gamma fraction, on the other hand, was believed to be identical with hemicelluloses and with the amorphous interfibrillar substance of the pulp, as suggested earlier by Algar, Giertz, and Gustefsson (*12*).

The work of Wilson has shown that TAPPI method T 203 m-44, used extensively in the United States for the determination of alpha, beta, and gamma-celluloses,

Table V. Multiple Correlation Study of Mannan Content, Pentosan Content, and Extrapolated Lead Tetra-acetate Values for Various Wood Pulp Samples

Sample no.	Extrapolated $Pb(OAc)_4$ values, mols. $\times$ 10^4 per mol. pulp	Mannan content, %	Xylan content, %
1 (cotton linters)	6.8	0	0.5
2	12.0	0.70	1.02
3	12.0	0.50	0.60
4	19.5	1.24	1.13
5	22.8	1.15	1.32
6	22.5	1.83	1.33
7	19.0	1.86	1.51
8	19.5	1.64	1.40
9	23.5	1.38	1.25
10	25.5	1.66	1.31
11	32.2	2.10	1.58

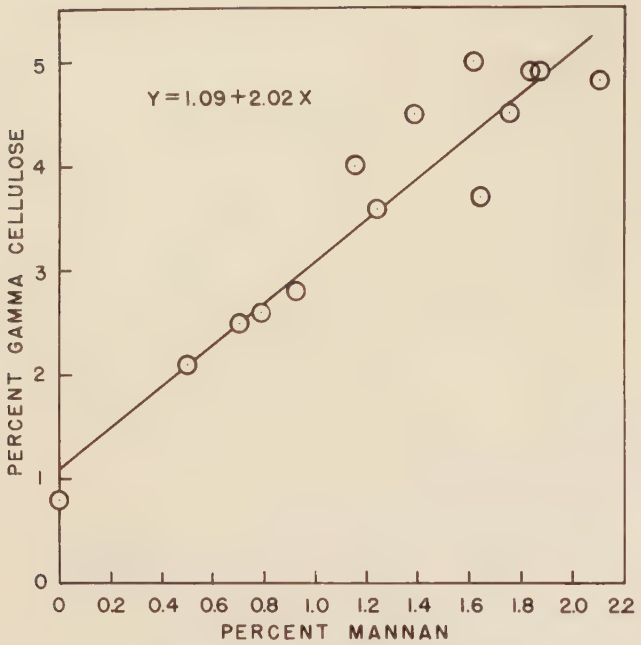

Fig. 9. Relationship between the gamma-cellulose content and mannan content of wood pulp

does not separate beta from alpha quantitatively because it employs caustic of decreasing strength. Beta-cellulose is only sparingly soluble in the initial 18% caustic used in the determination and attains maximum solubility at the final 10% sodium hydroxide concentration. Gamma-cellulose, on the other hand, increases in solubility with increasing caustic concentration. The method described by Ohlsson permits a more meaningful determination of the beta and gamma fractions.

If the gamma fraction contains the hemicelluloses, including mannan, then the gamma-cellulose content of the pulps, as determined by the Ohlsson method, should show an excellent correlation with mannan content and viscosity ratio. Accordingly, gamma content was determined on a series of pulps previously described. The values obtained are shown in Table IV and the relationship between the gamma content of the pulp and the viscosity ratio of the corresponding cellulose acetate is shown in Fig. 8. Similarly, in Fig. 9, the relationship between mannan content of cellulose and gamma content is demonstrated. The correlation coefficients of these curves are significant at the 1% level and indicate a high degree of reliability. The beta content, on the other hand, does not appear to be related to either mannan content or viscosity ratio, thus lending substance

Table VI. Relationship of Mannan Content and Pentosan Content to Viscosity Ratio for Several Cellulose Acetates

Sample no.	*Viscosity ratio*	*Per cent mannan in cellulose acetate*	*Per cent pentosans in cellulose acetate*
1	16.6	..	0.35
2	19.8	0.72	0.48
3	23.2	..	0.50
4	26.2	0.85	..
5	30.1	0.88	0.52
6	35.0	..	0.63
7	38.2	1.14	..
8	40.9	..	0.54
9	44.4	1.10	0.38
10	46.0	1.02	..
11	59.7	1.32	0.57

to the belief that most of the hemicelluloses are pre in the gamma fraction.

Since the gamma fraction should contain xylan as as mannan, it was felt, on the basis of these results, some thought should be given to the contribution of hemicellulose to the anomalous viscosity behavior o cellulose acetates under investigation.

XYLAN CONTENT OF WOOD PULPS; RELATION TO LEAD TETRA-ACETATE CONSUMPTION OF P AND VISCOSITY RATIO OF CELLULOSE ACET

Paper chromatography of hydrolyzates from v pulps used in this investigation showed the presen glucose, mannose, and xylose only; xylose appeare be the only pentose present. The xylan content of t pulps was, therefore, determined using the exce method of O'Brien and Davis (*13*) for pentosans. results of these determinations are recorded in Ta IV and V. It will be noted that, as the mannan cor decreases, the pentosans also decrease. This is, perh not surprising due to the additional purification volved in removing mannan.

Previously, the initial rapid reaction obtained w these pulps were treated with lead tetra-acetate been ascribed to the presence of mannan only, a correlation has been shown between mannan cor and lead tetra-acetate consumption. It is now appa that a correlation would be obtained between pento and lead tetra-acetate consumption. However, a tiple correlation analysis of the data of Table V cated that 52% of the variance in lead tetra-ac consumption was due to mannan and only 12% to tosans. The remainder (36%) is probably due to reaction with amorphous cellulose.

It is not surprising, again, to find that the pentos xylan content of these wood pulps show an exc correlation to the viscosity ratio of the cellulose ace prepared from them (Fig. 10). Xylans, or mannan xylans, are also directly related to gamma cor (Table IV) as might have been predicted. It therefore, difficult to assess the relative contributi these two hemicelluloses to the phenomenon unde

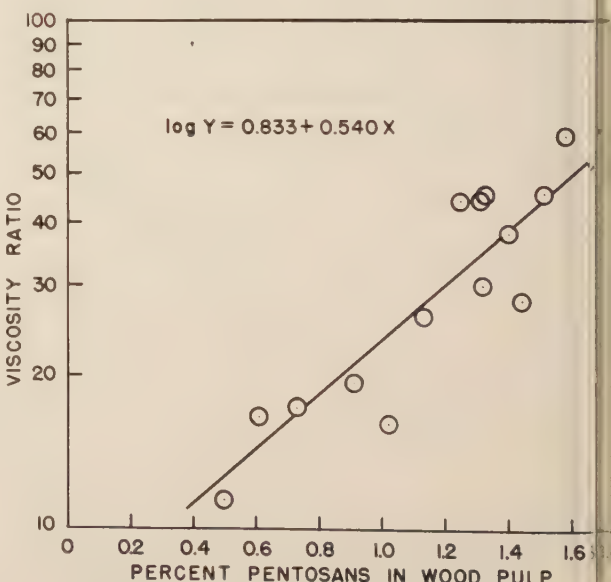

Fig. 10. Relationship between the pentosan conte wood pulp and the viscosity ratio of the correspon cellulose acetate

Table VII. Effect of Heating an Acetic Acid Solution of Cellulose Acetate at an Elevated Temperature (125°C.) on Mannan and Pentosan Content in Relation to the Viscosity Ratio

Sample no.	Time of treatment at 125°C.	Viscosity ratio	Per cent mannan in cellulose acetate	Per cent pentosans in cellulose acetate
1	None	16.1	0.66, 0.61 } Av. = 0.64	0.47, 0.48, 0.50 } Av. = 0.48
	2 hours	14.1	0.41, 0.54, 0.38, 0.54 } Av. = 0.47	0.45, 0.48 } Av. = 0.46
2	None	45.3	1.26, 1.17 } Av. = 1.22	0.59, 0.52 } Av. = 0.56
	2 hours	14.4	0.54, 0.32 } Av. = 0.43	0.45, 0.48 } Av. = 0.46

vestigation. It was necessary, at this point, that additional information be obtained by a study of the hemicelluloses in the cellulose acetates, the viscosity ratios of which were known.

MANNAN AND XYLAN CONTENT OF CELLULOSE ACETATE SAMPLES

Samples of cellulose acetate prepared from pulps of known hemicellulose content, and on which viscosity ratios had been determined, were hydrolyzed and the hydrolyzates analyzed for mannan and xylan by the methods previously described for the determination of the amount of these hemicelluloses in wood pulp. Results obtained are recorded in Table VI. Additional data are obtained from Table VII.

In Figs. 11 and 12 the values for mannan and xylan, respectively, in the cellulose acetates, have been plotted against the logarithm of the viscosity ratio. An excellent correlation appears to exist between the mannan content and the logarithm of the viscosity ratio as demonstrated by the calculated correlation coefficient (0.97). On the other hand, the correlation coefficient ($F = 0.42$) for the relationship of pentosan or xylan content with the logarithm of viscosity ratio, as shown in Fig. 12, is not significant statistically. This is true, despite the fact that the pentosan contents of the wood pulps used for preparation of the cellulose acetates showed a good correlation with viscosity ratio (see

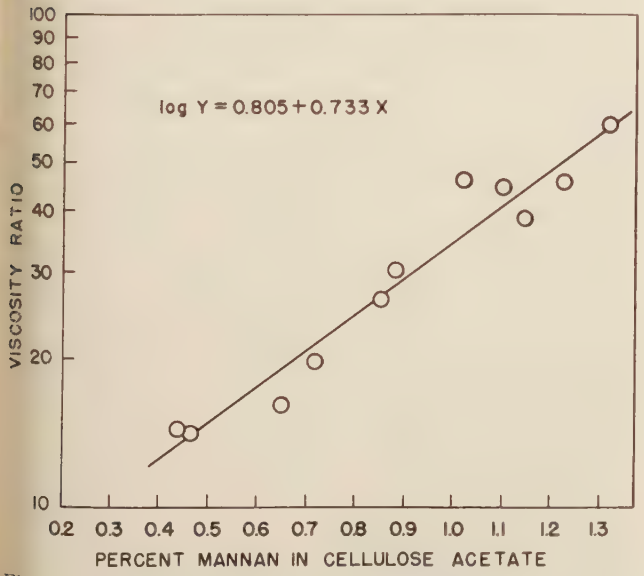

Fig. 11. Relationship between the mannan content of cellulose acetate and viscosity ratio

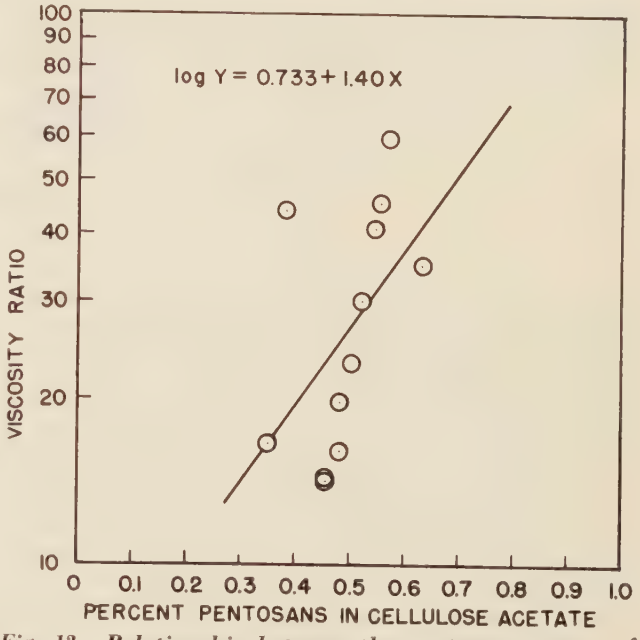

Fig. 12. Relationship between the pentosan content of cellulose acetate and viscosity ratio

Table IV and Fig. 10). Apparently the acetylation process is extremely effective in reducing the pentosan content and considerably less effective in removing mannan. The residual pentosans, after acetylation, are therefore quite low and reasonably uniform and show poor correlation with viscosity ratio. The quantity of mannan, on the other hand, is substantial even after acetylation and it shows a considerably better correlation with log of viscosity ratio.

It has also been observed that certain treatments of cellulose acetate, such as heating in acetic acid solution under pressure, result in decrease in the viscosity ratio of the precipitated cellulose acetate. When the reprecipitated material is hydrolyzed and the mannan content of the hydrolyzate determined, it is found to be considerably lower than that of the original acetate after hydrolysis (Table VII). Again, it is apparent that a decrease in mannan content is accompanied by a decrease in viscosity ratio of the cellulose acetate.

No mechanism has yet been established to explain the effect of mannan upon the viscosity of cellulose acetate. The fact that mannan is difficult to remove during acetylation, as shown in the previous paragraphs, points to its being bound to the anhydroglucose chain in the form of a branch or cross link. The existence of such structures might well explain the observed viscosity

phenomenon. A thorough investigation of the mechanism is essential to verify the conclusions advanced here.

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The authors wish to thank Elizabeth Barabash and Robert Painter laboratories for certain experimental data used in this paper and Rosenthal for assistance in the development of methods and handling cosity data.

Use of High Intensity Screens in Sulphate Pulp Handling Coarse Papers

F. COOPER RATLIFF

A Lindblad high intensity screening system was recently installed in Gaylord Container Corp.'s Bogalusa, La., sulphate pulp mill. This paper deals with the problem involved in expanding the screening operation, the solution of the problem, the results expected, and the results obtained from the completed installation. Economic studies by process engineering and construction engineering showed that while high intensity screens themselves were more expensive than other types the over-all installed cost was considerably less. It was expected that a maximum capacity of 500 tons of air-dry pulp per day through four Lindblad high intensity screens connected as planned would be obtained. The quality of the pulp was expected to be satisfactory for manufacture of cylinder liners, wrapping, and bag papers. Test results have shown that expected performance was obtained and it is believed that this type of screen was a satisfactory solution to the specific problem.

A Lindblad high intensity screening operation was started at the Gaylord Container Corp.'s Bogalusa, La., mill in the Spring of 1953. This installation was designed to handle 465 tons of unbleached sulphate pulp for the production of wrapping, bag, and cylinder liner grades.

The purpose of this paper is to discuss the problem of expanding the screening operation, the solution of the problem, the results expected from the solution, and the actual operation of the completed installation.

The new screening operation was to take the production of a new 465-ton vacuum washing system, equipped with preknotters and deliver the screened pulp at a sufficiently high consistency to be used on the paper machines.

The thickeners used after screening were to be of the vacuum type to fit into the system of water handling. At Gaylord thickeners are used after screening as a stock washing stage. The water flow through this system is as follows: paper machine white water is used as shower water on the filters following screening.

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Drainage from these filters is collected in a half m gallon reservoir and used (1) to dilute pulp for scree (2) to furnish shower water for knotters and scr (3) to furnish washing and dumping water to fusers, and (4) to furnish water to be heated and us the displacement showers of rotary washing system

The operators adjust the quantity of shower w used on the filters following screening to maintai level in the reservoir and prevent it from running

The rejects from the new screens were to be rescre by existing tailing equipment and used with semi-b cal pulp in the manufacture of corrugating mater

The screens were to be located in the bui erected to house the new washing system and placed floor immediately below the operating floor of the w ers.

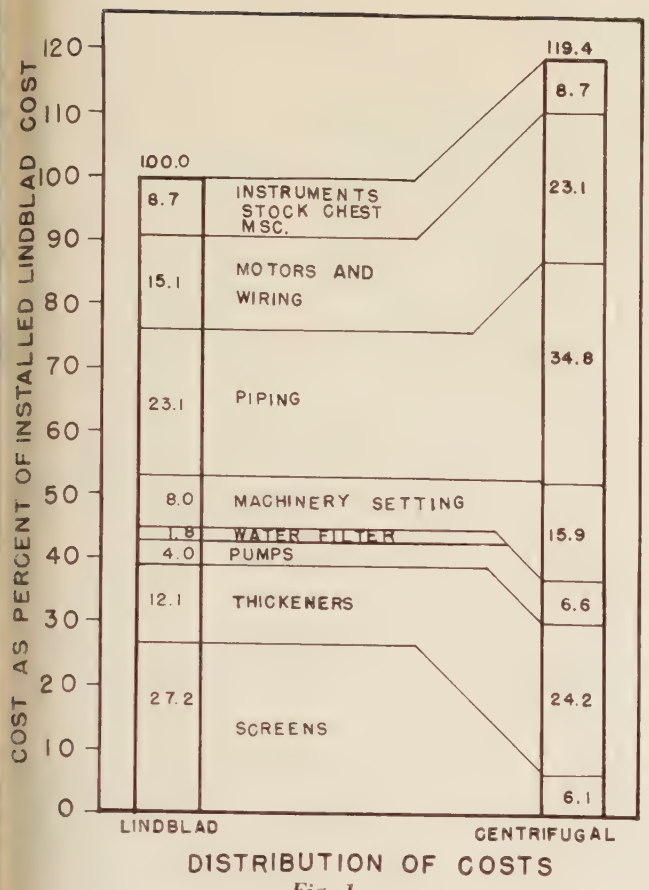
The quality of the screened pulp was to be as or better than the present 0.100-in. perforated centrifugal screens. Provisions were to be mad improve quality in the future by the use of sm openings in screen plates together with the installat more screens.

The cost was to be held to a minimum consistent good quality equipment and other provisions o problem as stated above.

This problem was specific and in some ways pec to our operations. The solution would also be exp to be specific to fit into our operation.

Problems of this nature at Gaylord's Bogalusa are divided into two phases of engineering. The which is called "process engineering," was in this responsible for (1) equipment sizing; (2) equip performance; (3) flow arrangement; (4) pump, w and pipe sizing; and (5) instrumentation. The w handled this phase of the problem as a member o technical department. The other phase handle the engineering department was responsible for (1) estimates, (2) construction drawing, (3) contra and (4) actual construction.

In the planning stage, several possible solutions worked out roughly, and approximate costs arriv



DISTRIBUTION OF COSTS

Fig. 1

and submitted to management. Management, from these data, was able to narrow the possibilities to 0.085 to 0.100-in. perforation centrifugal screens and 0.024-in. cut Lindblad high intensity screens, and because of other decisions made at this time, such as washing, restate the problem in the form previously referred to. Actual design of layouts and close cost estimates were then made on the two systems under consideration and resubmitted to management. With complete initial and operating cost estimates, together with estimated performance data, management was able to decide on a screening program.

COMPARATIVE COSTS

Figure 1 illustrates the distribution of costs of the two systems involved calculated as per cent of the total installed Lindblad operation cost.

The centrifugal screens themselves were much less expensive than the Lindblads. However, in this specific installation such factors as thickeners, pumps, piping, setting machinery, and motors and wiring brought the total cost of the Lindblad operation well below that of the centrifugal screens.

The factors that changed the total cost figures were consistency and power requirements. A flow of 465 tons of air-dry pulp at 0.70% moisture-free consistency that could be obtained with centrifugal screens represents a water flow of nearly 10,000 g.p.m. while the same production through Lindblads at 2.0% consistency requires 3400 g.p.m.

In this particular installation the water and pulp had to be pumped from the ground level to the elevation of the screens which was some 50 ft. high. The screened pulp flowed by gravity some 200 ft. to the thickener location. Piping, pump, and pump motor costs were thus much less expensive for the Lindblad installation because of higher consistency. Thickener capacity was also considered a function of consistency and in the actual arrangement of pulp distribution using some existing filters, the use of centrifugal screens would have required two new $9^1/_2$ by 14-ft. "valveless filters," while Lindblads would require only one.

Screen drive horsepower on the Lindblads was 106 while on the centrifugal screen drives would have been 200. The larger motors on the screens and those on the pumps, together with starters, transformers, and wiring made the differences in costs shown in Fig. 1 under motors and wiring.

The differences shown under machinery setting were due to setting the additional filters and pumps required for use with centrifugal screens.

A Cuno "Flow Klean" water filter was included in the Lindblad job to clean filter effluent for the low volume showers. The use of this water was necessary to maintain our closed system. On centrifugal screens with large volume water showers, this filter would not have been necessary.

Operating costs were estimated to be the same for the systems insofar as labor and maintenance were concerned. Capital costs including interests, insurance, and taxes were estimated at 15% of installed Lindblad cost per year for Lindblad screens and 17.9% for centrifugal screens on the same basis. This was directly proportional to the total first cost of the two systems. The annual power cost for Lindblad operation was estimated at 5.1%, while centrifugal screens would cost 8.5%, both on the same above-mentioned basis. Thus it was estimated that the annual operating cost of the Lindblad screening would be less than centrifugal screens by 6.3% of the installed cost.

The estimated cost figures arrived at by the combination of process and construction engineering, were a major factor in management's decision to install Lindblad high intensity screens to take care of the additional sulphate pulp production in the latest expansion program.

FLOW DIAGRAM

Figure 2 illustrates the flow diagram of the Lindblad screening. Unscreened washed pulp at controlled consistency enters the system through V-1, which is an air-operated V-port plug valve which controls the rate of pulp flow to the screens. Diluting water

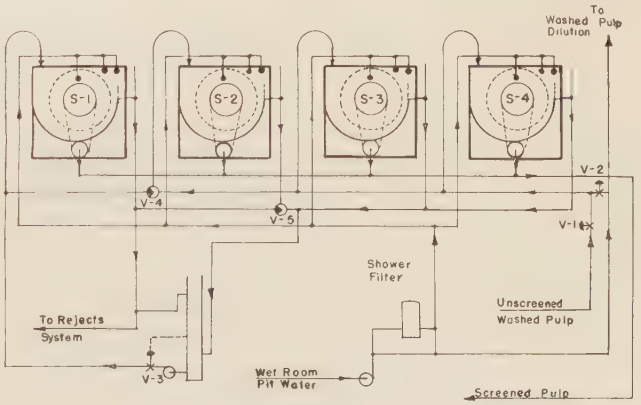


Fig. 2. Flow diagram

Table I

Test No. ⟶		1	2	3	4	5	6	7
Primary screens input	Fiber, tons/day	403	403	403	403	403	403	414
	Screenings, %	4.48	4.48	4.48	4.38	4.48	4.48	6.78
	Consistency, %	2.58	2.33	2.06	2.00	1.90	1.57	1.99
	Showers, g.p.m.	915	905	915	880	915	870	890
Accepted from primary screens	Fiber, tons/day	290	257	299	312	311	333	281
	Screenings, %	0.31	0.33	0.32	0.45	0.67	0.74	0.60
	Consistency, %	1.65	1.56	1.30	1.47	1.31	1.26	1.45
Primary rejects secondary input	Fiber, tons/day	113	146	104	91	92	70	133
	Screenings, %	14.1	11.5	16.2	18.1	16.9	22.2	19.1
	Consistency, %	2.16	2.17	2.00	1.42	1.33	1.22	1.89
	Showers, g.p.m.	305	265	305	265	305	270	270
Accepted from secondary screen	Fiber, tons/day	91	127	86	67	63	45	93
	Screenings, %	0.36	0.36	0.39	0.73	0.73	0.74	0.70
	Consistency, %	1.75	1.85	1.76	1.38	1.15	1.08	1.53
Rejects from secondary screen	Fiber, tons/day	22	19	18	24	29	25	40
	Screenings, %	69.1	84.6	85.7	71.4	53.6	61.1	61.8
	Consistency, %	1.17	1.03	1.38	0.70	1.02	0.91	1.37

[a] Two primary screens and one secondary screen on test 8. Three primary screens and one secondary screen on rest. Fiber, tons/day = air-dry tor fiber per day. Screenings = per cent of sample rejected by 0.012-in. laboratory flat screen. Consistency = per cent moisture-free consistency. Te Aug. 6, 1953; tests 7–8, Aug. 7, 1953. TAPPI no. pulp: Aug. 6, 1953, 25.2; Aug. 7, 1953, 25.4. Per cent screenings in pulp from 0.100 centrifugal sc Aug. 6 and 7, 1953, 0.70.

enters through V-2, which is an air-operated water valve. These two valves are operated from a panel at the screens and give the operator control over rate and consistency fed to the screens. Diluted pulp then flows to primary screens S-2, S-3, and S-4. Accepted stock from these screens flows to the thickeners. Rejects from the primary screens flow to a stand pipe where they are picked up by a stock pump and sent to the secondary screen S-1. V-3, an air-operated plug valve operated by a level control, maintains a constant level in the stand pipe, giving a smooth flow to the secondary screen. Accepted stock from the secondary screen joins that from the primary screens, while rejects go to the old tailing system. Valves V-4 and V-5 are plug valves that in the event of a shutdown of S-1 permit the use of S-2 as a secondary screen.

There were no test data on operation of Lindblad screens of the size installed, or on these screens with

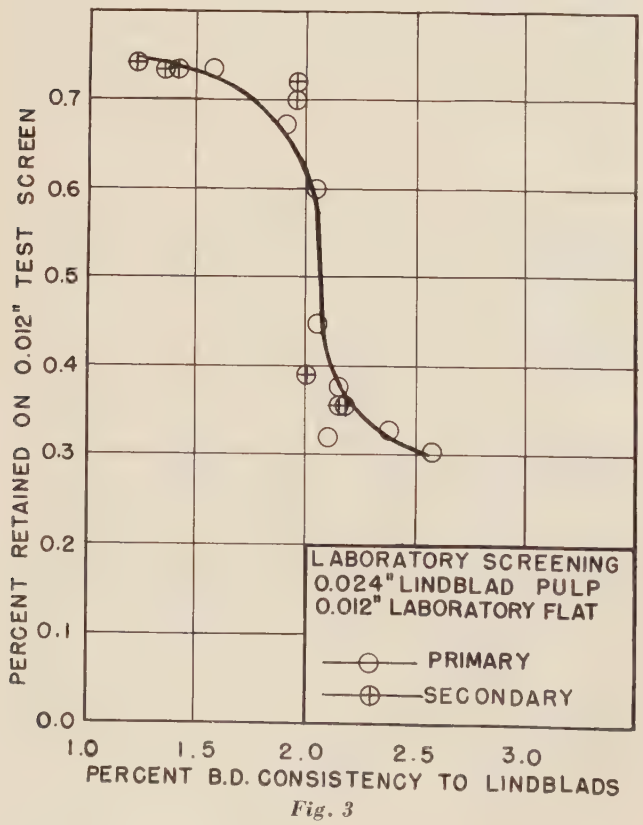


Fig. 3

0.024-in. slots. The information available was fr smaller screen of European manufacture with 0.0 slots. The available data indicated that the sc were not sensitive to shive concentration and that u overload conditions the throughput of accepted increased as well as the quantity of good pulp i rejects.

The choice of 0.024-in. slots was made on parative data from 0.100-in. perforation centri screens and flats with various cut sizes. The avai data on 0.014-in. Lindblads were compared with screen data. The thoroughput and shive count Lindblad and flat screens were assumed to be the ordered function of slot size. Flat screen slot were taken that would give equivalent or sli cleaner stock than 0.100 centrifugals. Then Linc slot sizes were calculated that would give equi or slightly cleaner stock than the flats. This ca tion was somewhat uncertain so the manufa agreed to give full credit for the 0.024-in. plate was found necessary to change them.

From each of the four Lindblad screens with 0.0 slots and the flow arrangement described, it wa pected that 125 tons of air-dry screened sulphate pul day or 500 total tons could be obtained. The pulp expected to be as clean, or slightly cleaner than obtained with the 0.100-in. perforation centrif It was also expected that the rejects would carry acceptable pulp from the system than the weigh the actual shives.

The system was expected to be self balancing in if one primary screen spilled large quantities of ac able pulp with rejects, due to such causes as sh stoppage, that the flow arrangement would allow secondary screen to reduce this loss until the cond could be corrected.

RESULTS

The Lindblad screens have been in operation some months at this writing. This is not long en time to give conclusive data on their performan durability. However, they have for this time live to expected performance. Production rates have as high as 470 tons per day for the four screens and have shown enough overload capacity to allow on be shut down for adjustment without interfering production. The screens appear to be less sens

than the 0.100-in. perforation centrifugal screens to pulp mill shock loads, such as raw cooks or periods of slick or poorly washed pulp.

On Aug. 6 and 7, 1953, test runs were made on the screens to determine the effect of consistency and load on over-all performance. The results of these tests are shown in Table I.

Figure 3 shows the effect of feed consistency on the shives left in the accepted pulp as determined by screening samples with a laboratory 0.012-in. cut flat. No theoretical reason is known why a sharp break should occur near 2.0% consistency. The manufacturers of the screens have worked out a new method of rejects removal that they believe improves cleanliness of accepted stock and reduces acceptable stock in the rejects. They also believe that this will eliminate the sharp break that was found. The points on Fig. 3 represent feed rates of from 69 to 146 tons per day per screen and screenings in the feed of from 4.5 to 22.2%. This indicates that the screening efficiency is not greatly affected by rate or proportion of screenings in the feed.

A study of Table I shows the self-balancing feature of the system. The quantity of pulp rejected by the primary screens showed considerable variation from test to test, but the secondary screen evened this operation, giving acceptable uniformity of rejects from the system. On tests run at 402.8 tons per day of feed the rejected material from the primary screens varied from 146.3 to 69.4 tons per day, while rejects from the system as a whole as indicated by total secondary rejects ran from 28.9 to 18.3 tons per day.

SUMMARY

From engineering planning, routine operation, and testing, the following conclusions may be drawn from Gaylord's high intensity screening operation.

1. The high intensity screens were found to be more economical to install under this mill's conditions than other types.

2. Power consumption for screening and pumping was less than could have been obtained with other screens.

3. The capacity of the screens and quality of pulp was as expected.

4. No maintenance figures are available at this writing.

APPENDIX

Calculations—Feed Rate

The calculation of feed rate to the screens involved a study of the preknotter ahead of washing. This paper is not concerned with this study except the determination of accepted stock rates.

Total input to the preknotter was determined by the rate of blowing cooks and change in blow tank level. During these studies the rate of feed to the preknotter was adjusted to give production rates equal to blow rates so no blow tank level connections were necessary.

Studies have indicated that the digesters used during these tests gave a total yield per cook of 3.76 tons of air-dry pulp at the TAPPI number to which it was cooked. On tests 1 to 6 blows were made at the rate of 114 per day giving a feed rate to the preknotter of 428.6 tons air dry per day.

F_K = feed to knotter as air-dry tons per day
A_K = accepted pulp from knotter as air-dry tons per day
R_K = rejects from knotter as air-dry tons per day
S_{FK} = portion of feed rejected by laboratory flat screen
S_{AK} = portion of accepted stock rejected by laboratory screen
S_{RK} = portion of rejects rejected by laboratory screen

$$A_K = F_K - R_K \qquad (1)$$

$$R_K = F_K \left[1 - \frac{(1 - S_{AK})(1 - S_{AK}S_{RK})}{(1 - S_{FK})(1 - S_{RK})S_{AK}} \right] \qquad (2)$$

Example—tests 1–6:

$F_K = 428.6$
$S_{FK} = 0.099 \quad S_{AK} = 0.0448 \quad S_{RK} = 0.945$

Substituting in equations (1) and (2):

$A_K = 403$ air-dry tons per day

A_K, the accepted stock from the preknotter, was washed and sent to the stock chest used to feed the screens. The retention time in this chest was long enough to average the pulp for any group of tests run. The level of this chest was held constant so feed rates to the screens were held to the same values as accepted stock from the preknotter.

Pulp Balance on Primary Screens

$F_P = A_K$ = feed to primary screens as air-dry tons per day
A_P = accepted pulp from primary screens as air-dry tons per day
R_P = rejects from primary screens as air-dry tons per day
S_{FP} = portion of feed rejected by laboratory screen
S_{AP} = portion of accepted stock rejected by laboratory screen
S_{RP} = portion of rejects rejected by laboratory screen

$$A_P = F_P - R_P \qquad (3)$$

$$R_P = F_P \left[1 - \frac{(1 - S_{FP})(1 - S_{RP}S_{AP})}{(1 - S_{AP})(1 - S_{AP})S_{RP}} \right] \qquad (4)$$

Example—test 1:

$F_P = A_K = 403$ air-dry tons per day
$S_{FP} = S_{AK} = 0.0448 \quad S_{AP} = 0.0031 \quad S_{RP} = 0.141$

Substituting in equations (3) and (4):

$R_P = 113$ air-dry tons per day
$A_P = 290$ air-dry tons per day

Pulp Balance on Secondary Screen

$F_S = R_P$ = feed to secondary screen as air-dry tons per day
A_S = accepted pulp from secondary screens as air-dry tons per day
R_S = rejects from secondary screen as air-dry tons per day
S_{FS} = portion of feed rejected by laboratory screen
S_{AS} = portion of accepted stock rejected by laboratory screen
S_{RS} = portion of rejects rejected by laboratory screen

$$A_S = F_S - R_S \qquad (5)$$

$$R_S = F_S \left[1 - \frac{(1 - S_{FS})(1 - S_{RS}S_{AS})}{(1 - S_{AS})(1 - S_{AS})S_{RS}} \right] \qquad (6)$$

Example—test 1:

$F_S = R_P = 113$ air-dry tons per day
$S_{FS} = S_{RP} = 0.141 \quad S_{AS} = 0.0036 \quad S_{RS} = 0.0117$

Substituting in equations (5) and (6):

$R_S = 22$ air-dry tons per day
$A_S = 91$ air-dry tons per day

Water Balance

The shower volumes were calculated from water balances using pulp figures calculated as above and consistency determinations reported in Table I.

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The author wishes to thank the management of Gaylord Container Corp. for the use of the data contained in this paper and permission to publish them. We are indebted to Charles Hundemer of the Gaylord Engineering Department whose cooperation during the course of this study contributed very materially to its success. All of our calculations and test results were based on the laboratory determinations of J. K. Dyer and R. E. Smith of the laboratory department whose assistance was much appreciated.

Emulsion Xanthation of Cellulose

Part VI. Influence of Cold Alkali Treatment of Cotton Linte and Wood Pulp Upon Emulsion Xanthation

OLOF SAMUELSON, ROLAND H. ANDERSSON, and FRED GÄRTNER

Previous papers in this series showed that there were differences in the behavior of a normal viscose pulp and a cold alkali refined (mercerized) pulp during emulsion xanthation. This paper is concerned with a detailed study of the influence of cold alkali treatment upon the dissolution of cotton linters and wood pulp during emulsion xanthation. The amount of undissolved residue after emulsion xanthation is unchanged as long as the sodium hydroxide concentration in the cold alkali treatment does not exceed 12%. No change in the DS of the undissolved residue was detected. When the sodium hydroxide concentration exceeds 12% the undissolved residue decreases, the lowest value being at 16% caustic. The DS increases as the concentration is increased to 20%. Washing conditions after mercerization are of importance. Treatment with sodium chloride solution directly after mercerization with 25% NaOH at 20°C. results in a better dissolution throughout the whole range of sodium hydroxide concentrations. Drying at elevated temperatures has a more marked influence on wood pulp than for cotton linters. In general, elevated temperature during drying has a detrimental effect on dissolution. The DS of the residue increases on repeated treatment with sodium hydroxide and carbon disulphide and there is a marked difference between the behavior of cotton linters and wood pulp.

In previous papers (*1*, *2*, *3*) in this series it has been shown that remarkable differences exist in the behavior of a normal viscose pulp and a cold alkali refined (mercerized) pulp during emulsion xanthation. The mercerized pulp was found to be more difficult to bring into solution than the untreated pulp. Rayon is easier to dissolve than sulphite pulp but after mercerization it is necessary to increase the sodium hydroxide concentration in the xanthation considerably in order to obtain a complete dissolution. The aim of the present work is to investigate more in detail the influence of a cold alkali treatment upon the dissolution of cotton linters and wood pulp during emulsion xanthation.

EXPERIMENTS AND RESULTS

Technique of Emulsion Xanthation

The emulsion xanthation and the determination of undissolved cellulose were carried out as described in a previous paper (*1*). In cases where it was difficult or impossible to separate the fibers from each other by shaking in the lye, the pulp was dry-defibered in a disintegrator before the emulsion xanthation. Experiments have shown, that for samples which are easily defibered in the lye the same results are obtained whether the pulp has been dry-defibered or not. In order to eliminate any influence of differences in the resin content of the samples, most of the experiments were performed in the presence of a wetting agent highly sulphonated castor oil in the concentratio 0.2 gram per liter being used. The amount of cellu and carbon disulphide were 0.5 gram and 1.5 ml. spectively, while the sodium hydroxide concentra was varied. Unless otherwise stated the washing was of the concentration 60 grams NaOH per liter

Technique of Cold Alkali Treatment

The conditions during cold alkali treatment, adop in most of the experiments were as follows. The sam was treated with sodium hydroxide solution un stirring for 1 hr. at 20°C. after which the lye was canted and the pulp transferred to a great beaker c taining distilled water. Then the solution was suc off through a glass filter. The washing with disti water was repeated several times. In order to rem the last traces of alkali the pulp was immersed in di acetic acid and once again carefully washed with wa The pulp was dried in the air at room temperature.

Influence of Sodium Hydroxide Concentration in C Alkali Treatment

In the experiments American cotton linters an mildly hot alkali refined sulphite pulp from spruce w used. The analytical data are given in a previ paper [pulps L and B2 (*2*)].

Six grams of the pulp were treated with 600 ml. sod hydroxide solution, the concentration of which varied between 2 and 25% NaOH (by weight). A washing and drying the pulp was conditioned in a de cator at 65% relative humidity. The yield of c alkali-resistant cellulose in the treatment of pulp calculated on dry pulp is presented in Fig. 1. W linters pulp the yield did not fall below 98% at concentration of sodium hydroxide.

The results from the emulsion xanthations are p sented in Figs. 2 and 4 as plots of undissolved resi against the concentration of the sodium hydrox solution used in the cold alkali treatment of the pr The different curves correspond to different sodi hydroxide concentrations in the emulsion xanthati The degree of xanthation (DS) of the undissolved resi was determined according to Barthelemy and Willia (*2*) and is shown in Figs. 3 and 5.

Emulsion Xanthation of Native and Mercerized Cot Linters at High Sodium Hydroxide Concentration

Native and mercerized cotton linters were emuls xanthated at a sodium hydroxide concentration of grams NaOH per liter according to the standard p cedure without the addition of wetting agent. amount of carbon disulphide was varied between 0 a 0.50 ml. The results are presented in Fig. 6.

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Emulsion Xanthation of Cellulose "Micelles" from Native and Mercerized Wood Pulp

As starting material in these experiments a bleached sulphite pulp from spruce was used (alpha-cellulose, 88.0%; viscosity, TAPPI 230, 23 cp.). Mercerization of the pulp was performed with 18% sodium hydroxide

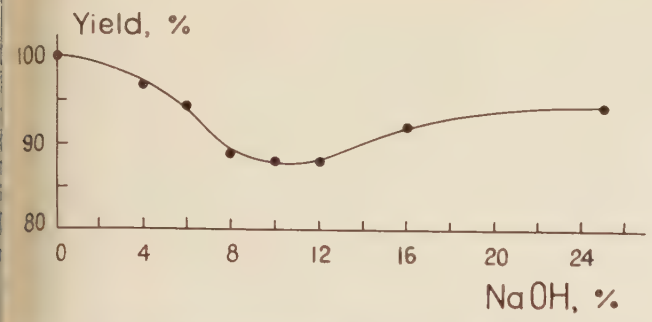

Fig. 1. The yield of cold alkali-resistant cellulose for wood pulp (B2) at varying NaOH concentrations

under the conditions described above. Cellulose sols were prepared from the native and mercerized samples according to a method described by Rånby (*8*). Seventy-five grams air-dried cellulose was boiled in 1200 ml. of sulphuric acid for different lengths of time. Further data on the hydrolyses are given in Table I. The hydrolyzed samples were washed in 250-ml. centrifuge tubes (15 min. in a field of about 1000 G). From the collected washing liquors the peptized cellulose "micelles" were flocculated by the addition of small amounts of dilute hydrochloric acid. The precipitate was allowed to settle and the supernatant solution decanted. The residue was centrifuged and made up with water to give a cellulose concentration of 0.5 gram per 20 ml. The yields of peptized cellulose for different times of hydrolysis were about the same as the figures reported by Rånby.

The suspension was vigorously shaken to assure homogeneity and 20-ml. aliquots were taken with a pipet treated with an organo-silicon compound (Desicote). The samples were transferred to the usual reaction vessels. At the same time the cellulose concentration in the suspension was determined by drying a 20-ml. aliquot overnight at 105°C. Water and sodium hydroxide (250 grams per liter) were added to the reaction tubes to give 50 ml. of the desired NaOH concentration. An addition of 1.5 ml. carbon disulphide was used in all experiments. The emulsion xanthation (varying NaOH concentrations) and subsequent washing were performed according to the standard procedure. No wetting agent was added. In the experiments at NaOH concentrations of less than 60 grams per liter the washing was carried out at the same concentrations as used in the emulsion xanthation. The undissolved residue was taken up on a glass filter crucible (Jena 1 G 3) and dried overnight at 105°C. The results are listed in Table I.

In order to determine the DP of the hydrolyzed cellulose, samples of the suspension were taken and diluted with cupriethylenediamine solution and water to obtain solutions of varying cellulose concentrations and 0.5 *M* in cupriethylenediamine. From viscosity measurements in an Ostwald viscosimeter the intrinsic viscosity was determined by extrapolation to zero concentration and the DP calculated according to Staudinger's law ($K_m = 6.25 \cdot 10^{-3}$).

Influence of the Washing Conditions After Cold Alkali Treatment

Cotton linters and wood pulp were mercerized in two different ways:

1. Ten grams of the dry-defibered sample were immersed in 1 liter of a 25% NaOH solution under vigorous stirring for 1 hr. After the mercerization period the lye was diluted with distilled water to a concentration of 10% NaOH by weight. The mixture was kept overnight in a refrigerator at +3°C. Then the pulp was washed and dried according to the standard procedure.

2. The treatment with the 25% NaOH solution was performed under the same conditions as described for method 1. Then the excess of lye was filtered off and

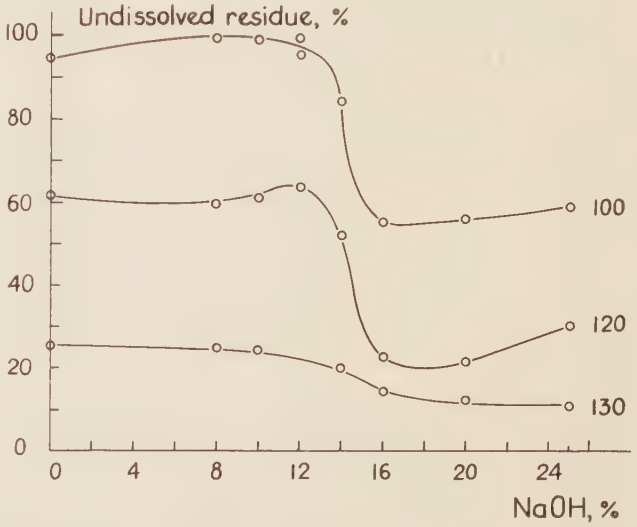

Fig. 2. The xanthation residue of cotton linters after cold alkali treatment with NaOH of varying concentrations
The different curves correspond to different NaOH concentrations (grams per liter) in the emulsion xanthation.

Table I. Emulsion Xanthation of Cellulose "Micelles" from Native and Mercerized Wood Pulp

Sample	Concentration of H_2SO_4 in hydrolysis, N	Time of acid hydrolysis, hr.	Intrinsic viscosity in 0.5 M $CuEn_2(OH)_2$	DP	Undissolved residue (%) after emulsion xanthation at varying NaOH concentrations, g./l. 40	50	60	70	80	90
Wood pulp	2.5	16	1.08	175	75.8	62.7	48.0	20.2	2.3	0
	2.5	168	0.72	115	62.2	50.6	42.3	24.2	2.2	0
Mercerized wood pulp	2.5	16	0.39	60	46.0	33.9	23.6	10.4	0.7	0
	2.5	3	0.47	75	38.8	31.7	26.3	15.6	2.1	0
	5.0	1/6	0.55	90	45.5	33.8	21.5	10.2	1.7	0

the residue suspended in 3 liters of a saturated sodium chloride solution. After 15 min. the solution was sucked off and the immersion in NaCl repeated once. The washing and drying of the sample was carried out according to the standard procedure.

The yields of mercerized cellulose according to methods 1 and 2, respectively, were for cotton linters 98.5 and 99.6%, and for wood pulp 85.4 and 93.6%.

Table II. Emulsion Xanthation of Cotton Linters After Cold Alkali Treatment with 16% NaOH and Drying Under Various Conditions

NaOH, g./l.	*CS_2, ml.*	*Undissolved residue, %*		
		Wet pulp	*Pulp dried at 20°C.*	*Pulp dried at 90°C.*
100	1.0	86.1	65.1	72.5
120	1.0	31.9	32.8	37.1
130	1.0	21.4	19.8	22.5

The emulsion xanthation was performed with 1.5 ml. CS_2 and at varying concentrations of NaOH. The results are presented in Figs. 7 and 8.

Influence of Drying

The linters pulp was treated with a 16% NaOH solution and the wood pulp with a 10.5% solution in

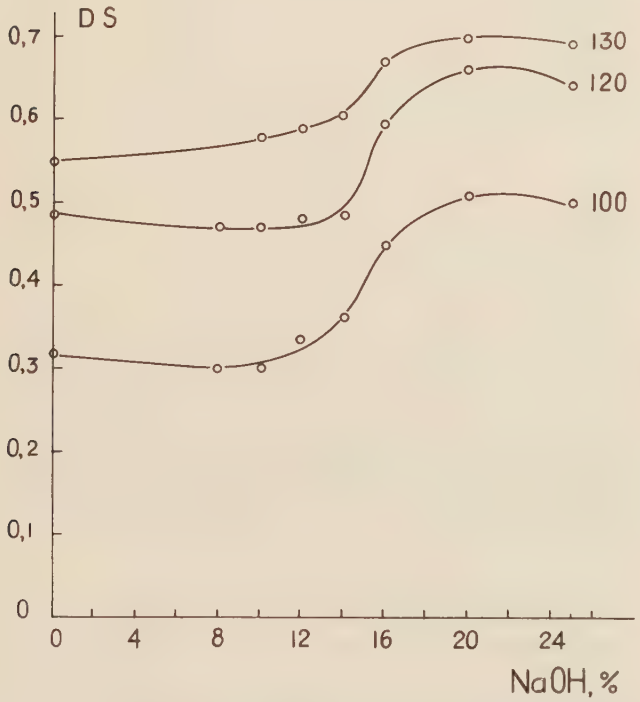

Fig. 3. The degree of substitution (DS) of the xanthation residue of cotton linters after cold alkali treatment with NaOH of varying concentrations

The different curves correspond to different NaOH concentrations (grams per liter) in the emulsion xanthation.

the usual way. After washing the pulps were pressed between filter papers in order to remove the excess water. The wet samples were emulsion xanthated at varying NaOH concentrations and with a constant amount of CS_2 (1.0 ml. per 0.5 gram air-conditioned pulp).

Another part of the cold alkali treated pulp was dried at 20°C. for 2 days and a third part was drie 6 hr. at 90°C. These samples were conditioned at relative humidity and emulsion xanthated at var NaOH concentrations and with an addition of 1.0 CS_2. The results are presented in Tables II and I

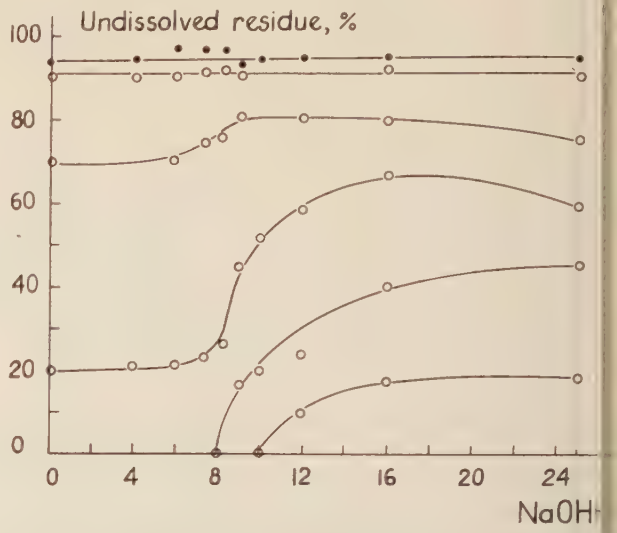

Fig. 4. The xanthation residue of wood pulp (B2) cold alkali treatment with NaOH of varying concentra

The different curves correspond to different NaOH concen tions (grams per liter) in the emulsion xanthation.

Repeated Emulsion Xanthations

Wood pulp (B2), mercerized wood pulp (E2), cotton linters (L) were emulsion xanthated in the u way with a constant amount of CS_2 (0.25 and 1.5 and at varying NaOH concentrations. Immedi after the xanthation period (6 hr.) the samples taken out of the thermostat and centrifuged.

Table III. Emulsion Xanthation of Wood Pulp (B2) Cold Alkali Treatment with 10.5% NaOH and Drying U Various Conditions

NaOH, g./l.	*CS_2, ml.*	*Undissolved residue, %*		
		Wet pulp	*Pulp dried at 20°C.*	*Pulp dri 90°C*
60	1.0	96.5	98.5	99.8
80	1.0	86.9	87.1	91.5
90	1.0	61.1	56.8	75.4
100	1.0	36.0	33.4	49.0
110	1.0	20.4	22.0	29.3
120	1.0	7.1	6.0	9.7

clear solution was decanted and the undissolved res transferred back to the reaction tube. After thes dition of NaOH and CS_2 of the same concentration in the same quantity as in the first emulsion xantha the samples were shaken for another 6 hr. in the ther stat. The undissolved residue and its DS were de mined after the samples had been kept in the ther stat for 16 hr. A comparison between the effec one and two treatments in the emulsion xantha is given in Table IV.

In a second series of experiments wood pulp (mercerized wood pulp (E2), cotton linters (L),

Table IV. Comparison Between the Effect of One and Two Emulsion Xanthations

NaOH, g./l.	CS_2, ml.	Linters (L) 1 treatment Undissolved residue, %	Linters (L) 1 treatment DS	Linters (L) 2 treatments Undissolved residue, %	Linters (L) 2 treatments DS	Wood pulp (B2) 1 treatment Undissolved residue, %	Wood pulp (B2) 1 treatment DS	Wood pulp (B2) 2 treatments Undissolved residue, %	Wood pulp (B2) 2 treatments DS	Mercerized wood pulp (E2) 1 treatment Undissolved residue, %	Mercerized wood pulp (E2) 1 treatment DS	Mercerized wood pulp (E2) 2 treatments Undissolved residue, %	Mercerized wood pulp (E2) 2 treatments DS
80	0.25	...	...	...	...	78.1	0.110	58.2	0.209	87 4	...	75.9	...
100	0.25	...	...	...	...	43.3	...	11.5	...	85.0	0.170	71.2	0.254
120	0.25	71.2	0.190	58.3	0.265	25.0	...	1.2	...	68.1	...	30.0	...
125	0.25	...	...	...	...	20.5	...	0.0	...	58.6	...	15.8	...
140	0.25	5.8	...	0.6	...	19.1	...	0.0	...	30.7	...	10.9	...
160	0.25	5.6	...	0.0	...	18.7	...	0.0	...	28.1	...	0.0	...
180	0.25	12.0	...	1.1	...	22.0	...	0.2	...	35.3	...	4.0	...
60	1.5	...	...	...	...	97.0	0.215	90.3	0.342	96.0	...	90.1	...
80	1.5	...	...	...	...	62.1	...	3.5	...	86.6	...	53.3	...
90	1.5	99.0	...	92.7	...	19.8	0.452	2.0	0.569	73.0	...	27.9	...
100	1.5	90.7	...	83.9	...	0.0	...	0.0	...	54.2	0.520	7.4	0.641
105	1.5	...	...	...	...	0.0	...	0.0	...	30.1	...	0.0	...
110	1.5	82.2	...	61.9	...	0.0	...	0.0	...	15.0	...	0.0	...
120	1.5	61.0	0.531	38.3	0.650	0.0	...	0.0	...	0.0	...	0.0	...
130	1.5	24.0	...	8.6	...	0.0	...	0.0	...	0.0	...	0.0	...

mercerized linters (18% NaOH) were emulsion xanthated five times, 1.0 ml. CS_2 being added, except in the fifth treatment where the amount of CS_2 was reduced to 0.25 ml. The amounts of undissolved residue in experiments at varying sodium hydroxide concentrations are given in Table V. In experiments carried out at concentrations of less than 60 grams per liter, the washing was performed at the same concentration as used in the emulsion xanthation.

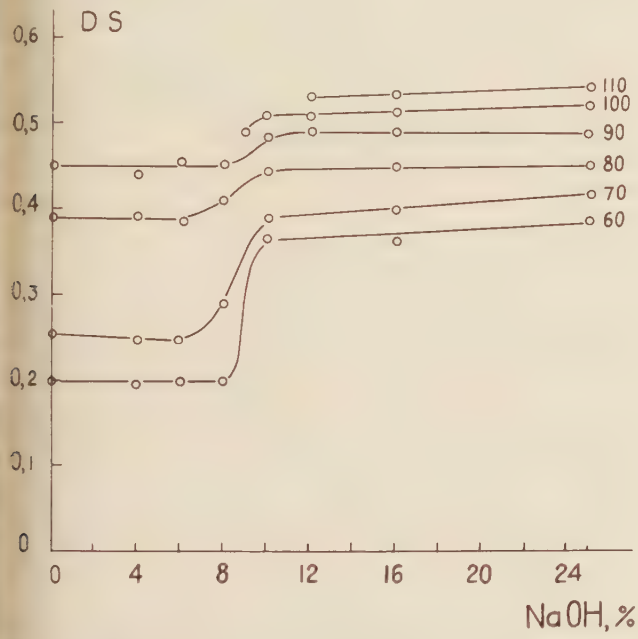

Fig. 5. The degree of substitution of the xanthation residue of wood pulp (B2) after cold alkali treatment with NaOH of varying concentrations

The different curves correspond to different NaOH concentrations (grams per liter) in the emulsion xanthation.

DISCUSSION

The results presented above show that there exists an important difference in the behavior of cotton linters and wood pulp during emulsion xanthation. The mercerized cotton linters is more easily dissolved than the untreated linters, whereas a mercerized wood pulp is more difficult to bring into solution than the original pulp.

In the experiments with cotton linters the amount of undissolved residue after emulsion xanthation is unchanged as long as the sodium hydroxide concentration in the cold alkali treatment does not exceed 12% (Fig. 2). Nor can any change in the DS of the undissolved residue be detected (Fig. 3).

Table V. Per Cent Undissolved Residue Obtained After Five Emulsion Xanthations at Varying NaOH Concentrations

NaOH, g./l.	Linters (L)	Mercerized linters	Wood pulp (B2)	Mercerized wood pulp (E2)
40	98.1	...	94.7	90.4
50	96.7	87.0	91.7	86.7
60	95.7	76.4	46.4	52.7
70	92.4	61.6	6.2	24.6
80	86.2	40.0	0.0	5.2
90	74.9	18.3	0.0	0.0
100	56.1	4.7	0.0	0.0
110	28.2	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0

When the NaOH concentration in the cold alkali treatment exceeds 12%, the undissolved residue is decreased. The lowest value is reached at a concentration of 16% NaOH. About the same figures are obtained at 20 and 25% NaOH. The DS of the linters samples increases as the concentration of the sodium hydroxide solution in the cold alkali treatment is increased from 12 to 20% NaOH.

For cotton linters an improved dissolution in the emulsion xanthation and an increased DS of the undissolved residue occur at about the same concentrations (above 12% NaOH) of the liquor used in the cold alkali treatment. For the sulphite pulp the decreased dissolution (Fig. 4) and increased DS (Fig. 5) of the residue both occur when the concentration is raised above about 8%. These concentrations are largely the same as those required for the transformation of cotton and wood pulp into cellulose II (*5*).

As shown in an earlier paper the crystallites are split up in those parts of the cellulose which go into solution during emulsion xanthation (*6*). X-ray measurements of the cellulose regenerated from the undissolved residue have shown that for sulphite pulp, sulphate pulp, and cotton linters a correlation exists between the concentration required for an intracrystalline swelling and the concentration at which considerable dissolution

occurs during emulsion xanthation (*7*). With the experimental method used it was only possible to study samples of native cellulose.

The intracrystalline swelling of the cellulose during emulsion xanthation occurs at a lower NaOH concentration than in sodium hydroxide without the presence of carbon disulphide (*7*). However, the sulphite pulp which gives an intracrystalline swelling at the lowest

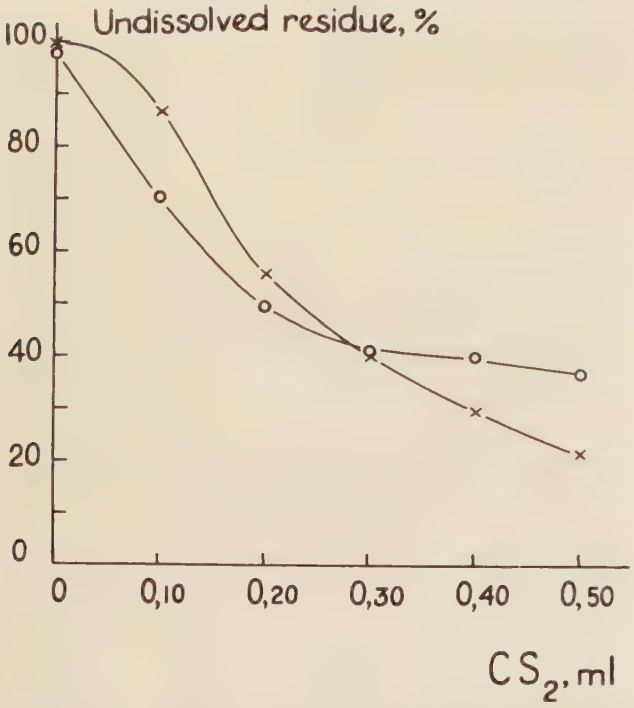

Fig. 6. The xanthation residue of cotton linters and mercerized cotton linters at varying amounts of CS_2 and constant concentration of NaOH (135 g./l.)

o—o, linters; x—x, mercerized linters (18% NaOH; 1 hr. at 20°C.).

concentration in pure sodium hydroxide solution also shows an intracrystalline swelling at the lowest concentration during emulsion xanthation, whereas for cotton linters a higher concentration is required in both cases. In emulsion xanthation (*7*) as well as in the absence of carbon disulphide (*8*) sulphate cellulose holds an intermediate position.

It may therefore be justified to consider the order in which the cellulose samples are transformed into sodium cellulose I on treatment with sodium hydroxide, as the order in which an intracrystalline swelling occurs during emulsion xanthation.

Calkin (*9*) has shown that the formation of sodium cellulose I begins at about 11% NaOH for mercerized cotton whereas for native cotton the corresponding value is about 13%. In the presence of carbon disulphide the intracrystalline swelling should occur at somewhat lower concentrations but the order must be expected to be unchanged. In the emulsion xanthation (Fig. 4) only negligible dissolution occurs for the untreated cotton linters when the concentration of the sodium hydroxide in the emulsion xanthation is 100 grams NaOH per liter. For the mercerized sample a considerable dissolution (about 40%) is obtained at this concentration. The different behavior of the original linters pulp and the mercerized linters may be explained by the different alkali concentrations required to afford an intracrystalline swelling.

The increased resistance against dissolution w appears after mercerization of wood pulp canno explained by an increased resistance against intrac talline swelling.

The experiments with cellulose "micelles" from na and mercerized wood pulp were undertaken in orde eliminate the influence of the fiber structure. As is dent from electron microscopic investigations by R (*8*) the fiber structure is completely destroyed after hydrolysis and subsequent peptization. The res presented in Table I show that after the fiber has l destroyed wood pulp behaves in a similar manne cotton linters, i.e., the "micelles" from mercerized c lose are more easily dissolved than the "micelles" f the native cellulose.

As far as the "micelles" are concerned the differe in molecular weight cannot be neglected since the n the various samples probably affects the dissolutio some extent. Such a dependence on the DP was a ally found for the native "micelles," but could no established in the case of mercerized "micelles," sam of DP 60 and 90 giving about the same undisso residues after emulsion xanthation. In this connec it may be mentioned that the experimental error

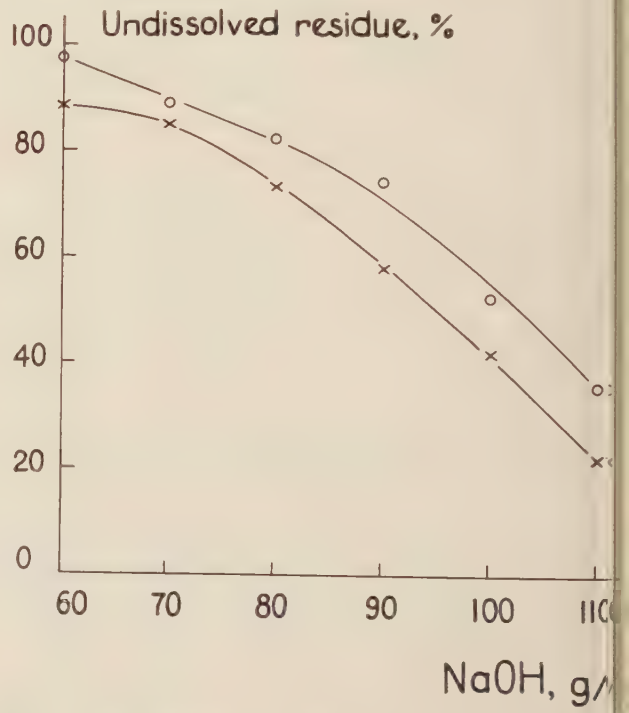

Fig. 7. The xanthation residue of cotton linters at vary NaOH concentrations and a constant amount of (1.5 ml.)

o—o, washing according to method 1; x—x, washing accordin method 2.

these emulsion xanthations were somewhat higher th in experiments with common cellulose samples.

Samples of equal DP from mercerized and native cel lose could not be prepared which makes a direct co parison impossible. From the data listed in Tabl the conclusion can be drawn that the fine structure the "micelles" has a greater influence than the DP. any case it is evident that the "desolubilization" eff

which occurs after mercerization of wood pulp does not exist in the isolated "micelles."

It must be assumed that mercerized wood pulp in analogy with cotton linters requires a lower NaOH concentration to give an intracrystalline swelling than the untreated pulp. The anomalous behavior of mercerized wood pulp during emulsion xanthation must consequently be ascribed to the fiber structure itself and not to the properties of the crystallites. The increased reactivity with CS_2 after mercerization, indicated by the increase in DS gives rise to a rapid xanthation which favors a macroheterogeneous course of reaction and prevents a more even xanthation throughout the fiber. The experiments presented indicate that also in the case of cotton linters there occur two counteracting effects after mercerization. The macroheterogeneous effect can be detected only in experiments at high NaOH concentration where an intracrystalline swelling would occur also in the absence of CS_2. However it is only at low additions of CS_2 that the mercerized sample is more difficult to bring into solution whereas at higher additions the results are in agreement with those presented previously, i.e., the mercerized sample is more easily dissolved. A probable explanation is offered by the

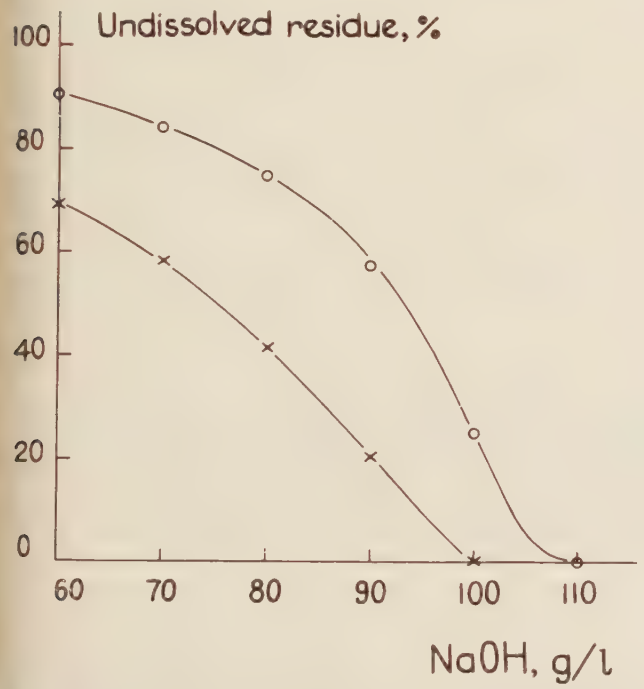

Fig. 8. The xanthation residue of wood pulp at varying NaOH concentrations and a constant amount of CS_2 (1.5 ml.)

o—o, washing according to method 1; x—x, washing according to method 2.

theory put forward above: the crystalline areas in cotton linters are more easily xanthated after mercerization.

The assumption of a macroheterogeneous course of reaction is supported by a microscopic investigation which was carried out with isotropic filaments prepared according to Hermans (*10*). It was shown that the reaction starts at the surface of the fiber and proceeds toward the center with a rather sharply developed boundary zone. The microphotograph presented in Fig. 9 shows the cross section of some mercerized filaments, emulsion xanthated for 30 min. at a NaOH concentration of 30 grams per liter and with excess CS_2. After careful washing the fiber was soaked in a hot solution of lead acetate for 30 min. and subsequently air-dried.

For both cotton linters and wood pulp the washing conditions after mercerization are of importance for the

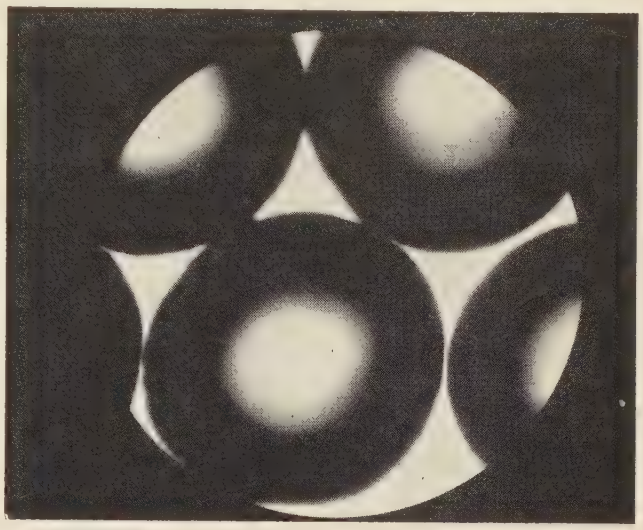

Fig. 9. Microphotograph of a cross section of mercerized fibers, emulsion xanthated for 30 min. with 1.5 ml. CS_2 and at a NaOH concentration of 30 g./l. (×60)

dissolution in emulsion xanthation as can be seen from Figs. 6 and 7. The procedure according to method 2 (treatment with sodium chloride solution directly after mercerization with 25% NaOH at 20°C.), results in a better dissolution throughout the whole range of NaOH concentrations. The difference in yield of mercerization for the two methods cannot explain the effect. No significant differences have been observed as far as the degree of substitution is concerned.

Only a few data have been reported earlier on the effect of drying upon the dissolution of mercerized cellulose in emulsion xanthation. For rayon it was shown (*1*) that a decreased dissolution occurs not only if the fibers are dried after mercerization but also if the sample after mercerization and subsequent washing with water is emulsion xanthated directly without drying. The influence of drying is further elucidated by the data presented in Tables II and III. For cotton linters as well as for wood pulp the undissolved residue is, within the limits of experimental error, the same whether the samples are emulsion xanthated in a wet or in an air-dry condition. Drying at 90°C. results in a decreased dissolution. This influence of drying at elevated temperature is more marked for wood pulp than for linters. A recent contribution to the subject of drying has been made by Barchewitz, Henry, and Chédin (*11*) who found that the decreased reactivity of cellulose after drying could be ascribed to the formation of hydrogen bonds. Infrared spectrophotometric measurements showed that in cellulose samples dried in vacuum about 99% of the hydroxyl groups were linked by hydrogen bonds.

The experiments presented in Table IV show that

when the residue of partially xanthated cellulose is shaken once again with sodium hydroxide and carbon disulphide a considerable dissolution occurs. The pulps can be brought into solution quantitatively by emulsion xanthation at a lower sodium hydroxide concentration if the xanthation is performed twice. The DS of the residue increases on repeated treatment with sodium hydroxide and carbon disulphide.

Furthermore it is obvious that the difference in dissolution between the common sulphite pulp (B2) and the mercerized pulp (E2) is smaller after two treatments than after one treatment. This shows that the decreased dissolution which occurs after mercerization of the wood pulp is not due to an absolute hindrance. This is confirmed by the results presented in Table V. In this table the amounts of undissolved residue after five treatments are reproduced. All samples are dissolved to a larger extent after five treatments than after one but from these experiments it is evident, that there is a marked difference in the behavior of cotton and wood pulp. With cotton linters there exists a large difference between the native fiber and the mercerized fiber not only after one emulsion xanthation but also after five treatments, the dissolution being much better with the mercerized sample. With wood pulp, on the other hand, where after one emulsion xanthation the original pulp is much more easily brought into solution than the mercerized sample, it is shown that the difference in dissolution is evened out to a large extent when the treatment is repeated five times. At a very low concentration of sodium hydroxide during the emulsion xanthation the mercerized wood pulp (despite the increased alpha-cellulose content) is dissolved even more easily than the original pulp. These experiments strongly support the theory put forward above that the cold alkali treatment brings about two effects which counteract each other as far as the dissolution duri emulsion xanthation is concerned. At a low sodi hydroxide concentration the positive effect (an int crystalline swelling under milder conditions) is pre lent whereas at high sodium hydroxide concentrati the negative (macroheterogeneous) effect predominat With cotton linters where the native cellulose is m difficult to bring into solution, the positive effect is most important but the parallelism in behavior betwe mercerized wood pulp and cotton linters in the expe ments carried out under different washing conditi (Figs. 7 and 8) indicates that a negative effect exi also in the case of cotton linters.

In this connection it may be mentioned that m cerization brings about a decreased dissolution in cup ethylenediamine solution both for wood pulp and cotton linters (*12*).

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The ASME Boiler and Pressure Vessel Code and Its Application in the United States and Canada

E. C. KORTEN

This article presents an exposition of the organzation and function of the ASME Boiler Code Committee with a brief outline of some of the reasons for its existence. It explains the interrelationship of the Code Committee, the enforcement authority, the inspecting agency, the manufacturer, and the user of boilers and pressure vessels. It tells what the user needs to know about actual application of the Code in the United States and Canada. It points out some of the more common pitfalls encountered in trying to obtain pressure-carrying equipment complying with Code and legal requirements and erects a few guide posts pointing the way to obtaining such equipment with a minimum of friction and misunderstanding.

THERE are those who believe that an understanding of the reasons for a requirement or a command is not necessary in order to obtain compliance. In t belief that some understanding of the whys and whe fores helps in remembering requirements, fosters a m favorable attitude on the part of those who must co ply, and results in smoother achievement of their c sired objective, some explanation of how things ca to be as they are and how the Code Committee actua functions is included.

E. C. KORTEN, Assistant Chief Engineer, Boiler Div., Engineering Dept., The Hartford Steam Boiler Inspection and Insurance Co., Hartford, Conn.

WHY THE CODE CAME INTO BEING

As a background to the Code it may be of interest glance at some of the occurrences which brought into being and to summarize very briefly the princip reasons for these occurrences.

Records published in *The Locomotive* show that fr Oct. 1, 1867, to Jan. 1, 1909, a period of slightly ov 41 years, there occurred in the United States and ad

cent parts of Canada and Mexico 10,051 boiler explosions resulting in the deaths of 10,884 persons and the more or less serious injury of 15,634 others. The frequency of such disasters increased from about 95 per year in the 1860's to about 470 per year in the early 1900's, reaching its peak about the time of the publica-

Fig. 1

tion of the first edition of the Code. Since that time devastating explosions have declined steadily almost to the vanishing point.

The greatest loss of life from a single boiler explosion occurred on the Mississippi steamboat *Sultana* in 1865. She carried 2021 persons, most of them Union soldiers discharged from Southern prison camps. An early morning explosion of one of her boilers brought death to 1238 persons and injury to many others.

The greatest number of boilers involved in a single occurrence was 27. At a coal mine in Shamokin, Pa., there were 36 boilers, 34 in. in diameter, 44 ft. long. The sheets were single-riveted and the heads were of cast iron. Early one Autumn morning in 1894, 27 of these boilers blew up "like a pack of firecrackers" as described by a witness. Figure 1 shows a general view of the wreckage. Six were killed, three injured.

Figure 2 shows the damage resulting from the explosion of a horizontal fire tube boiler in 1902. Fifteen were killed, twenty-one injured.

Figure 3 shows the property damage caused by the explosion of three water tube boilers in 1909. One was killed, one injured.

Figure 4 shows the extent of the wreckage caused by the simultaneous explosion of seven water tube boilers in a public utility plant in 1903. Eight were killed, twenty-one injured.

Lest the impression be created that paper mills are immune, Fig. 5 pictures the damage resulting from the explosion of a wood pulp digester in 1924. Three were killed, four injured.

Figure 6 is included not only because it shows the result of the explosion of a vertical water tube boiler in 1899, but also because there is a dynamic aspect to the remaining parts of the boiler that seems to fairly shout, "explosion!"

Disasters such as those illustrated rarely, if ever, happen today. When that statement is coupled with the fact that, during the period covered by the illustrations, the record shows that the frequency of boiler explosions in the United States and Canada was about nine per week, the question naturally arises as to why.

Strange as it may seem, the causes of boiler explosions have not been generally understood until comparatively recent times. As late as the 1880's and 1890's, and in some quarters even into the present century, there were those who believed and vigorously defended such theories as the dissociation of water into oxygen and hydrogen which somehow recombined to cause an explosion. Some held that explosions were caused by static electricity; just how is not explained. Old records repeatedly refer to "highly elastic steam" and to "sudden ebullition caused by water being thrown against overheated plates." Some just termed them" Acts of God," the general belief being that when the right combination of circumstances occurred, irresistible forces were generated within the boiler which would cause it to explode and that nothing could be done to prevent it.

The true causes of boiler explosions are pretty well understood today. They are: faulty design, faulty material or misapplication of material, faulty workmanship, undetected deterioration in service, and human failure. Failure of protective devices, such as sticking safety valves, are properly attributed to human failure to check and maintain such devices.

Mention of undetected deterioration calls to mind a type which is one of the most insidious and difficult to detect. It was the cause of many of the catastrophes already referred to and it defied detection until S. F. Jeter, then chief engineer of The Hartford Steam Boiler Inspection and Insurance Co., developed in 1914 a method of detection. Although riveted longitudinal lap seams are few in number today, the infamous lap seam crack may still lurk in remaining installations to bring disaster on the unwary.

The fact that a few such seams still do exist, the difficulty of detection, and the potential hazard if undetected, presents an irresistible temptation to digress for a moment and call attention to Fig. 7 which pictures the villain. A cylindrical vessel containing a longitudinal lap seam cannot possibly be a true circular cylinder. When such a vessel is subjected to pressure,

Fig. 2

a couple is created as indicated by the arrows, with the result that the lap tends to rotate as shown. With continued application and relief of pressure, cracks eventually develop as indicated at A and B. Note that they are hidden by overlapping metal.

Notching the calking edge at from 1 to 3 ft. intervals along its length and slotting the outer plate with a $^1/_4$ or $^5/_{16}$-in. cape chisel as shown in Fig. 8 will reveal existing cracks when a hydrostatic test is applied and will serve as telltale should cracks develop during service.

SOME STEPS LEADING TO THE WRITING OF THE CODE

Although the appalling loss of life and extensive property damage caused by explosions of pressure-carrying equipment continued for many years and periodically caused expressions of indignation in the press, effective action toward prevention was a long time in coming.

As early as 1830 the Franklin Institute appointed a committee "to examine into the causes of explosions of the boilers on board steamboats, and to devise the most effectual means of preventing the accidents or diminishing the extent of their injurious effects." While nothing was ever done to implement the committee's findings, the reports of the investigations make interesting reading (*3*).

In 1866 a group of men in Hartford, Conn., implemented their ideas about prevention of boiler explosions by organizing a company to inspect boilers periodically and to guarantee the safety of boilers so inspected by the issuance of a policy of insurance against explosion. This was later supplemented by the issuance of standard specifications for boiler construction. Boilers ordered to these specifications were inspected by the company in the shop during construction. This fact had an important bearing on the selection of inspectors to operate under the Code.

Fig. 3

The American Boiler Manufacturers Association, organized in 1887, tried to set up some generally acceptable standards. But fear of one another as competitors and reluctance to relinquish individual pet practices prevented agreement.

Note that no action having the force of law had as yet been taken. It was not until after the explosion a horizontal fire tube boiler in a shoe factory in Brockton, Mass., in April, 1905, that any legislative action was taken. That accident took the lives of 58 persons injured 117, did a quarter of a million dollars property damage, and brought claims totaling $280,000 for p

Fig. 4

sonal injury. Incidentally, that explosion was caused by a lap seam crack. It resulted in enactment by the Commonwealth of Massachusetts in 1907 of the first code of rules for the construction of steam boilers.

Colonel E. D. Meier, a member of The American Boiler Manufacturers Association, was among the first to see the need for uniform rules governing the design and fabrication of boilers. After many years of unsuccessful effort in that direction, he was elected president of The American Society of Mechanical Engineers in 1911. He succeeded in persuading the Council of the Society to appoint, "A committee to formulate standard specifications for the construction of steam boilers and other pressure vessels and for their care in service."

THE BOILER CODE COMMITTEE

The first committee consisted of seven members, a consulting engineer, two professors of engineering, two boiler manufacturers, one material manufacturer, and one boiler insurance engineer. The advisability of including more general representation soon became apparent with the result that an advisory committee was appointed representing boiler and pressure vessel manufacturers, users, designers, material manufacturers, accessory manufacturers, and boiler insurance company engineers.

The first Code made its appearance in 1914. It was a relatively simple document of 114 pages, exclusive of the index, and included specifications for materials, rules for the design of power boilers and low pressure heating boilers, and brief requirements regarding existing installations. Strangely enough, this first Code made no reference to shop inspection of power boilers nor the preparation and signing of data sheets. This omission was rectified in the 1918 edition. World War I interfered with completion of the committee's original a

signment but each year from 1921 to 1926, inclusive, saw the issuance of a new section of the Code as follows:

I	Power boilers	1914
II	Materials	1924
III	Boilers of locomotives	1921
IV	Low pressure heating boilers	1923
V	Miniature boilers	1922
VI	Inspection	1924[a]
VII	Care of power boilers	1926
VIII	Unfired pressure vessels	1925
IX	Welding qualifications	1940

Welding qualification requirements first appeared in 1937 as a supplement to the Unfired Pressure Vessel Code.

[a] Incorporated in Section I, Power Boilers, in all editions since 1924 until annulled and omitted from the 1952 edition.

Shortly after the appointment of the original committee it was enlarged by including the members of the

Fig. 5

advisory committee. Today there are 24 members of the main committee representing insurance, manufacturing, material producers, and users. The interests represented by members of the Code Committee is emphasized in answer to the often-heard complaint that those who must use the Code are not properly represented. That this criticism is not justified is further emphasized by the fact that there are now a number of auxiliaries to the main committee such as the Conference Committee, of which more will be said later, 15 standing subcommittees, and a varying number of special committees, all of which work directly with the main committee. The total membership of all committees exceeds 250.

Each subcommittee has on it one or more members of the main committee. With few exceptions, the subcommittee chairman is a member of the main committee, an arrangement which has obvious advantages. The remaining members of these subcommittees are experts in their particular fields which gives reasonable assurance of proper consideration and action on the diverse problems presented to the main committee.

All inquiries submitted to the Code Committee are given careful consideration. Usually they are referred to one or more subcommittees and these subcommittees make recommendations to the main committee.

The main committee meets at intervals of 6 or 7 weeks from September to June. Provision is made for the executive committee of the main committee to act on important items during the months of July and August.

About 5 years ago the custom of holding one meeting each year outside of New York City was established to give those who would not otherwise be able to do so an opportunity to obtain first-hand knowledge of the manner in which the Code Committee operates an also to enable them to take part in discussions.

After a subcommittee or a special committee to which a problem has been assigned has reached a decision either by correspondence or by a meeting of the subcommittee, a report is made to the main committee at which time all those who desire to be heard have and opportunity to speak. A formal vote is then taken. A single negative vote is sufficient to require reconsideration of the question. Those voting negatively are required to present their reasons in writing. These reasons are carefully analyzed by the subcommittee or special committee involved and this committee must report to the main committee, not later than the second

Fig. 6

subsequent meeting, what action is recommended and the reason therefor. After all those desiring to express an opinion have been heard, a vote is again taken. If three quarters of those present and voting are in the affirmative, the action is recorded in the minutes and becomes final, unless two negative votes are received in writing within 12 days of issuance of the minutes. In such case, the final action is negative.

Affirmative actions are published in *Mechanical Engineering* for comment. This is the mechanism by which manufacturers, users, or any interested parties may formally object to any action taken by the Code

Committee. Those interested in Code matters should therefore follow Code Committee actions in the monthly issues of *Mechanical Engineering* and comment on any items in which they are directly interested. Adverse comment receives consideration and is acted upon either affirmatively or negatively in the same manner as a new inquiry. If there is no unfavorable comment within 30 days after publication in *Mechanical Engineering*, the action of the main committee is approved by Council of ASME and is then published as an active code interpretation case or as a revision.

Code interpretation cases are published as soon as practicable after approval by Council and are immediately permissive. Usually code cases do not change code rules, but explain their intent. However, in those instances in which they do change rules, those changes become permissive upon issuance of the case and mandatory 6 months thereafter. Once annually, usually in August, addenda to the Code are published for the purpose of incorporating Code interpretation cases, eliminating inconsistencies or errors, clarifying the intent, and adding new requirements to keep pace with progress. These addenda are permissive on issuance and become mandatory 6 months thereafter. When addenda are published, affected Code interpretation cases are annulled.

On an average of once in 3 years, the Code is republished, the new edition incorporating therein all current code interpretation cases (except special rulings) and addenda so that effective cases and addenda are kept at a minimum.

The Code Committee does not review or comment on specific designs. Such review is the duty of the inspecting agency in the United States and of the provinical authority in Canada. The committee will consider all inquiries in the nature of requests for interpretation of existent requirements; requests for modification, withdrawal, or addition of rules; or requests for permission to use new material. All inquiries should be submitted in writing to the secretary. Requests

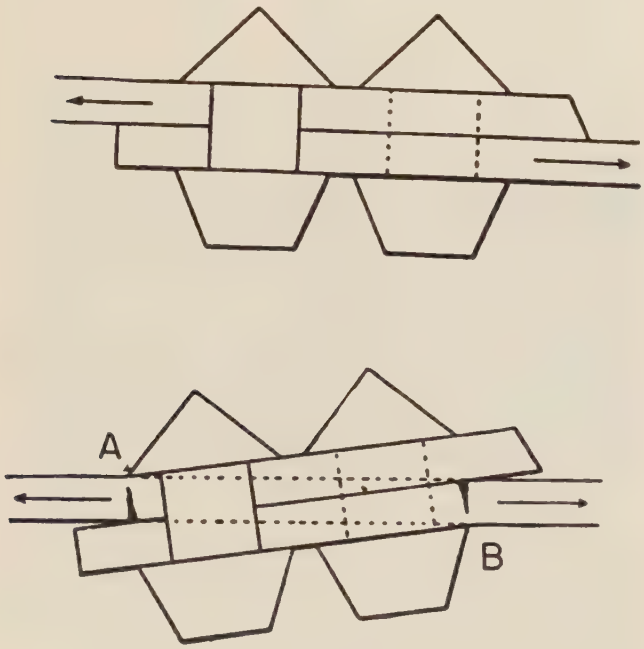

Fig. 7. Development of lap seam crack

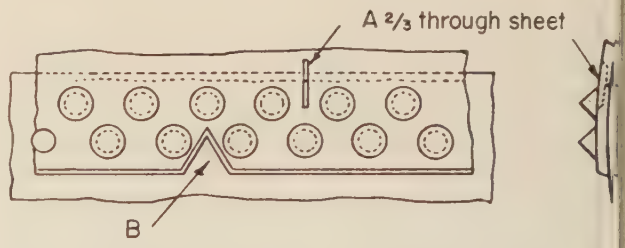

Fig. 8. Detection of lap seam crack

modification, withdrawal, or addition of rules sho be accompanied by a full explanation of the reasons requests together with any supporting argume Requests for use of materials not covered by the C should be submitted with the required supporting d

in accordance with Paragraphs A-75 to 85 of Power Boiler Code or Appendix B of the Unfired Pr sure Vessel Code.

Symbol stamps for marking equipment construc in accordance with the Code must be obtained fr The American Society of Mechanical Engineers. plicants are required to present evidence that they ha arranged for inspection by an authorized inspect agency. One of the most frequent errors made by plicants is to name an inspection agency on the assu tion that inspection service is available for the aski The demand for inspectors exceeds the supply. avoid the delay in obtaining symbol stamps an ap cant for a symbol stamp should not name an inspect agency unless he actually has an agreement for insp tion service with the agency named.

IMPLEMENTATION OF THE CODE

In developing the first Code the committee consid the problem of the method by which compliance co be made mandatory. It was soon realized that t could be done only by law-making bodies and that the very nature of things enforcement rested with legislative bodies of the several states and cities. order to cooperate with the states and cities and to tain their assistance, a Conference Committee was tablished shortly after publication of the first Co This committee consisted of the chief inspectors of cities and states which had assumed legal jurisdict over boilers. The Conference Committee now inclu the chief inspectors of any state or city which has corporated any section of the Code into its laws. C ference Committee members have the right of parti pation in discussions and voting at any regular meeti of the Boiler Code Committee.

As previously mentioned, the Code consists of ru for the fabrication, inspection, and testing of new boil and pressure vessels. The big problem was to find spectors qualified to see that the requirements of Code were carried out. It was logical to delegate t task to inspectors employed by the legal jurisdict but in many instances the staff was too few in numb It was therefore necessary to broaden the field fr which inspectors could be drawn and this was done turning to those who had had inspection experien namely, the boiler insurance companies.

The Code therefore now requires that inspections d

ing fabrication be made by a state inspector, a municipal inspector, or an inspector regularly employed by an insurance company. It is required that the qualifications of all such inspectors shall have been determined by written examination as prescribed by the rules of any state or municipality which has adopted the Code. Inspectors passing such examinations are commissioned as individuals to act for the state or city. Insurance inspectors are individually responsible to the issuing authority for their acts under their commissions. These commissions are valid only as long as the inspector remains in the employ of the carrier by whom he was employed when the commission was issued.

Those who are familiar with the Code will probably have noted that Paragraph UG-91 of the 1952 edition makes provision for inspections by inspectors continuously employed by a company for making inspections of unfired pressure vessels to be used by such company and not for resale. The Code requires that vessels inspected by such inspectors shall be stamped with the word "USER" above the code symbol. The qualifications of user inspectors must also be determined by written examination but objects inspected by them cannot be moved from one jurisdiction to another but shall be installed in a designated plant of the inspector's employer and cannot be moved from that plant to another location without special permission from the enforcement authority.

In exercising their prerogatives, each jurisdiction enacted what it considered adequate safeguards. Naturally, they differed and this eventually brought about a situation which is best described by the Code Committee's own comments, "On account of this lack of uniformity in these laws, intolerable confusion has resulted. It is a practical impossibility for manufacturers to comply with all of the various rules for construction embodied in so many different state laws. . . . The urgent need, therefore, of uniform laws for the construction and safe operation of boilers is apparent."

Recognition of this situation brought about the organization in 1919 of the National Board of Boiler and Pressure Vessel Inspectors which has for its purpose, "promoting greater safety to life and property by securing concerted action and maintaining uniformity in the construction, installation, and inspection of steam boilers and other pressure vessels and their appurtenances, and to secure interchangeability between political subdivisions of the United States." Membership in the National Board is available to the chief inspectors or other officials charged with the enforcement of boiler and pressure vessel inspection regulations of any political subdivisions of the United States or Canada that have adopted the Boiler Construction Code of The American Society of Mechanical Engineers, and most of them are members.

Of the functions of the National Board, more will be said later. Suffice it for the moment to point out that over the years that body has gradually taken over the preparation of inspectors' examinations. National Board commissions are recognized by most states having boiler laws and a system of reciprocal commissions has gradually been established whereby various subdivisions of the United States will issue reciprocal commissions to inspectors who hold either a National Board commission or a commission from another state which has a boiler law equivalent to the law of the jurisdiction issuing the reciprocal commission.

Another result of recognition of the need for uniform requirements was the organization in the early 1920's of The American Uniform Boiler Law Society. It is supported primarily by boiler and pressure vessel manufacturers. Its objective is perfectly described in its name and that objective has the endorsement of boiler insurance companies. This society works directly with legislative bodies in acquainting them with what other jurisdictions have done and in pointing out the things which experience has shown should be avoided. Like all human endeavors, this one has not met with 100% success. But the organization has materially aided the cause of uniformity and continues to do so.

APPLICATION IN THE UNITED STATES

To date 32 states and 32 municipalities in the United States have boiler laws based upon Section I of the ASME Code. Fifteen states and 19 municipalities have requirements for ASME construction of unfired pressure vessels, but the field of application varies. For example, some cover only air tanks or liquefied petroleum gas containers, while others cover all vessels over a specified size and working pressure.

New Construction

It cannot be too strongly emphasized that the ASME Code is intended to cover only new construction. The Code requires inspection in the shop during construction by an authorized inspector. The Code holds the manufacturer responsible for compliance with its requirements and provides for the application of its official stamp to the completed object and the signing of a data report form to indicate compliance.

The inspector is required to check the mill test reports of material and to make the required inspections to satisfy himself that Code requirements have been met. He also signs the data sheet certifying to that effect. The inspector checks the design before fabrication is started in order to avoid costly alterations should some feature not in accordance with Code requirements later be found in actual construction. He also checks the manufacturer's welding procedures and his records of qualification of procedure and welders. Although the inspector is naturally answerable to his employer for his actions, the authority issuing his commission can revoke that commission for cause.

Most states accept inspection by a National Board commissioned inspector, but objects intended for installation in Pennsylvania or Ohio must be shop inspected by an inspector holding a commission from the state in which the object will be installed.

The requirement of inspection of new equipment carries over into the field in those instances in which the object cannot be completed in the shop. It is required that the authorized inspector witness the final hydrostatic test and in those installations requiring welding or other fabrication in the field, the inspector must make sufficient inspections during installation to enable him to certify to Code compliance.

The Code also requires that field fabrication and installation be performed by an organization holding one of the Society's symbol stamps. Originally this was the same organization that built the object in the shop.

But with the increase in size and complexity of boilers there gradually developed organizations devoting their entire time to the erection of boilers. Since the "S" stamp was intended for boiler manufacturers, it did not seem logical to issue that stamp to an organization which did not fabricate at all and therefore the "A" stamp came into being. It is intended for use by erectors who build no part of the boiler but merely assemble the items built by others.

In the days of threaded or flanged and bolted piping, no special manufacturing skill was required to erect a pipe line. But with the advent of welded piping, there developed companies specializing in the design and installation of welded pressure piping. Since they were neither boiler manufacturers nor assemblers, the "double P" stamp was brought into being for their use. Welded piping may be fabricated and erected by the holder of an "S" or a "double P" stamp and may be erected by the holder of an "A" stamp.

Mention of piping is a reminder that today piping is somewhat of an orphan. The Power Boiler Code defines a boiler as including all piping such as steam, feed, and blow-off lines up to and including certain stipulated valves and requires that all parts of a Code boiler be fabricated and installed by a properly recognized manufacturer. Most boilers as sold today by manufacturers terminate at the steam outlet flange. Consequently, someone must arrange for the piping to be installed by a properly qualified organization. If the inspector called in to witness the final hydrostatic test did not inspect the piping during installation, he is naturally going to ask questions about such piping. Unless it can be established that the piping was installed and inspected as required by the Code, the inspector cannot certify to Code compliance and the enforcement authority will refuse to issue a certificate of operation. Therefore, it is well for purchasers of Code boilers to make certain that arrangements have been made for erection of the piping falling within the scope of the Code to be performed by a properly qualified organization and for inspection to be made during erection by an authorized inspector.

Occasionally it may be necessary, particularly in unfired pressure vessel work, to build an object which includes material which does not appear in Section II or which departs from Code rules in some other respect. Such items should not be submitted to the Code Committee. The proper source of special dispensation in such cases is the enforcement authority having jurisdiction at the point of installation. The correct procedure is to lay all of the facts before the proper authority, giving the reasons why Code requirements cannot be met and requesting permission to operate the object at the point of installation. This may involve special stamping or other departure from the norm. The instructions issued by the enforcement authority should be followed meticulously.

Equipment in Service

Although the Code holds the manufacturer responsible for compliance with Code rules, the user is answerable to the enforcement authority for compliance with the law. The legislative body of the state or city enacts the law governing pressure-carrying equipment and charges the chief inspector, or other official or an appointed board or bureau of boiler rules with the sponsibility of administering the law. Such individu or groups have the power of amending boiler rules granting exceptions. Those jurisdictions having la stipulate construction in accordance with their o codes or the ASME Code, the former being based p marily upon the ASME Code. They also make th own rules regarding installation requirements and pe odic inspection after installation. Most jurisdicti require one internal and one external inspection year, the certificate of operation being issued at time of the internal inspection. Operation withou current certificate is illegal.

Inspections must be made by state, city, or insura inspectors, the same as in the case of shop inspecti Owner-user inspectors have recently received limit recognition. Inspectors are required to submit writt reports. Most jurisdictions accept these reports a issuance of certificates is based upon them.

Since the law holds the owner responsible, it is well those contemplating new installations to acqua themselves with local requirements. The best guide basic requirements is the National Bureau of Casua Underwriters' Bulletin "Synopsis of Boiler Laws, Ru and Regulations." This can be obtained from t Bureau at 60 John St., New York 7, N. Y., for a no inal sum. It is brought up to date annually. Ho ever, it should not be relied upon completely. Requi ments should be checked with the departments me tioned in the synopsis as having jurisdiction.

Repairs

Once a boiler or pressure vessel has been installed a inspected and a certificate of operation has been issue the requirements of the Code have been met and ceases to apply directly. The Code is not intended apply to repairs or alterations to objects in service. is not intended that organizations confining their a tivities to repairs be holders of code symbol stamp although holders of such stamps can, of course, ma repairs. It is desirable that repairs conform as close as possible to original construction. The Natio Board has issued a set of rules for repairs by weldi and also instructions for the design and installation riveted patches. Many jurisdictions have adopt these rules for repairs. Copies may be obtained fr the National Board of Boiler and Pressure Vessel I spectors, 145 North High St., Columbus 15, Ohio. all cases, the approval of the enforcement authori and the boiler insurance carrier should be obtained the owner before repairs of the type described are start on equipment covered by law. It not infrequent happens that repairs cannot be made to conform strict to National Board rules. This need not preclude t making of repairs. In such cases all that is necessa is to obtain the agreement of the owner, the enforceme authority, and the insurance carrier.

APPLICATION IN CANADA

Application in Canada roughly parallels that in t United States.

All of the provinces have now accepted constructi in accordance with the ASME Code. Many of the have also become members of the National Board ar accept National Board inspections. Each provin

has the power to make its own rules somewhat in the same manner as the states and cities of the United States.

Canadian Standards Association Standard B-51 is the guidebook and it has been accepted by all provinces. It is compiled and kept up to date by the Committee on Boilers and Pressure Vessels. Copies can be obtained from the Canadian Standards Association, Ottawa, Canada, for a nominal sum.

The major difference between the United States and Canada as respects new designs is that in the United States designs are reviewed by the inspecting agency. In Canada it is required that new designs be submitted to the chief inspector of the province in which the object will be installed. Approved designs will be assigned a registration number and no construction shall be started until such a number has been assigned. If alterations are made in the design after a registration number has been assigned, these changes shall also be submitted for approval. If the design is to be used in more than one province, registration in each such province is required.

SUMMARY

A few *do's* and *don'ts* which should prove helpful in dealing with problems involving the purchase and installation of pressure-carrying equipment:

do Check local legal requirements.

do Specify Code compliance when ordering.

do Consult your boiler insurance carrier concerning any controversial points on Code application.

do Consult your local enforcement authority on any matters involving legal requirements and on Code matters when no boiler insurance is carried.

do Require the manufacturer to secure proper review of the design.

do Be sure proper arrangements are made for field inspection during installation.

do See that piping falling within the scope of the Code is fabricated and installed by a properly qualified company and inspected by an authorized inspector *during installation.*

do Secure approval of the enforcement authority and the boiler insurance carrier of any non-Code construction

do Follow proposed Code changes as published in *Mechanical Engineering* and write the secretary when you are convinced that the proposed change will work a hardship.

do Keep up to date on the Code and subscribe to interpretation service.

(These latter two items apply especially to equipment manufacturers.)

do See that all designs are registered in all provinces in Canada in which they will be used.

don't Petition the Code Committee to authorize non-Code construction

don't Request the Code Committee to review specific designs.

don't Expect your boiler insurance carrier to make shop or field inspections of piping which is not included in the scope of the Code, except as may be required for insurance.

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An Engineering Analysis of Down Time of Electric Sectional Drives

R. F. SORENSON

Though much is heard about the merits of electric sectional paper machine drives as well as the various troubles encountered in their application, accurate records have not been available to make valuable appraisement and comparisons possible. The keeping of such records is not only possible, but was shown to be of value as an aid in analyzing and controlling lost time, improving interdepartmental relationships, and improving the attitude of operating electricians. Records will provide a basis for future comparisons with other mills in the industry and with other types of drives.

Paper quality, paper machine speed, and uninterrupted production have become increasingly important during the past few years. This has resulted in greatly increased efforts to control the many variables involved in the papermaking process. The paper machine drive so directly affects both quality and production there has been a constant effort to develop drives that are faster, more accurate, stable, and reliable. One of these developments is, of course, the electric drive with its different types of speed and position regulators. These drives have been applied to all types of paper machines making endless varieties of paper.

The electric drive is always the subject of much discussion whenever paper mill engineers get together. We hear much about the merits of the drive, the troubles encountered with various components of the drive, lost time improperly charged, speed variations that cannot be explained at the moment, and other maintenance problems. These discussions, by engineers thoroughly familiar with the drives, are generally lacking in one

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fundamental point. They are not backed by accurate records indicating either the relative merits of the drive or the seriousness of any difficulties.

Without accurate records it is impossible to make any true evaluation of the drive's performance and it is difficult to compare it with similar machines in other mills, or with types of mechanical drives. Furthermore, valuable comparison of efficiency of operation from one period to the next and determination of trends in the various causes of trouble are very difficult. Is it possible to get such records and what would be the advantages in having them?

METHOD OF HANDLING DATA

Last Fall at the Seventh Engineering Conference, the Electrical Committee appointed a subcommittee to make a study of the lost time on paper machines directly due to electric drives in order to obtain a figure that might represent the amount of electrical trouble to be expected on a drive and to promote orderly maintenance programs.

Questionnaires were sent to 12 mills, representing a wide variety of speeds and paper grades, asking them to

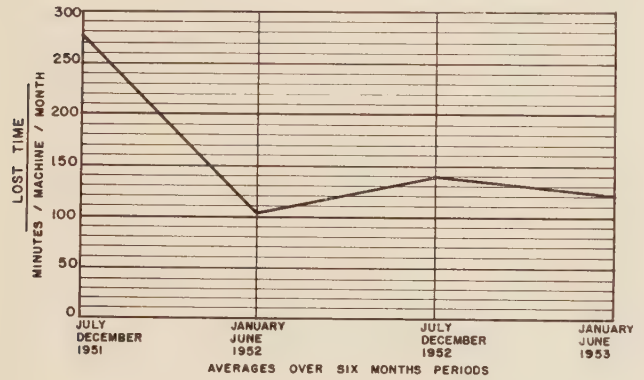

Fig. 1. Average electric drive lost time on four kraft paper machines and one board machine in the same mill over a 24-month period

participate in this program by supplying data on their operation. These data were handled through the TAPPI office where the information was coded and the mill's name kept confidential. The company manufacturing the drive was not listed. A standard form for reporting lost time has been developed because it is essential to have a common method of bookkeeping.

ADVANTAGES OF RECORDS

In order for such a program of bookkeeping to be acceptable, it must offer definite advantages to the individual mill and to the industry. Several mills that have been keeping records for the past two years have found them to be a distinct aid in: (1) improving interdepartmental relations, (2) improving attitudes on the part of operating electricians, and (3) analyzing and controlling lost time. Also, for the future it could provide a means for comparison with other mills in the industry and with mechanical drives.

No paper machine drive can be used to its fullest efficiency without complete cooperation between the papermakers and the maintenance groups. Cooperation grows out of confidence in each other, and confidence stems from a mutual knowledge that when

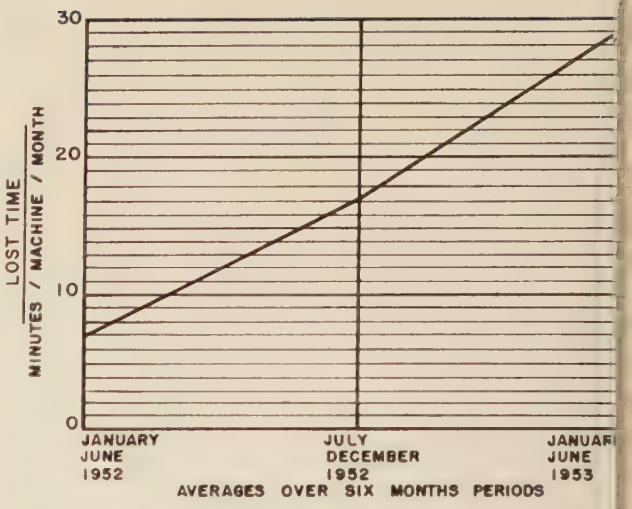

Fig. 2. Lost time due to regulator adjustments on fo kraft paper machines and one board machine in the sa mill over an 18-month period

problems exist every effort is being made to solve th problems in an organized manner. Records tabulat the types of troubles, their relative importance, a their trends from period to period provide a means bringing problems into the open. These records a invite more accurate assignment of lost time. No pro lem can be effectively attacked until it is accurately fined and then assigned to the department that c control it.

Much of the control of electrical lost time rests w the operating electricians. All of us like to know h good a job we are doing, that someone recognizes improvement, and that someone knows of our proble and stands behind us. Records make these things p sible. They give the electricians a base from which operate and an incentive to improve. Electric should be given a summary of the past year's lost ti record and a detailed monthly report of the curre lost-time figures.

Certainly a mill is interested in knowing if its l time figures compare favorably with other similar m and how it stands on individual items that can ca lost time. This information can emphasize the stro points, as well as the weak points in a mill's main nance program.

Finally, as an aid in analyzing and controlling l time, records can be of the greatest importance. Th records that have been discussed cannot be the prec

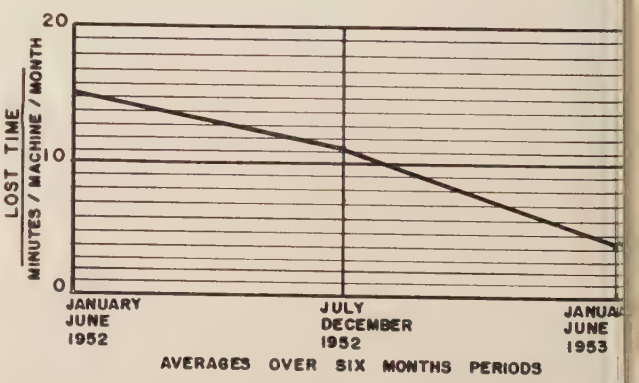

Fig. 3. Lost time due to relay and contactor coils on fo kraft paper machines and one board machine in the sa mill over an 18-month period

Lost Time on Electric Sectional Drives

(TAPPI Project No. _____)

Survey Code No. _____

Company: _____

Address: _____

Survey Code No. _____

1. Machine No. _____
2.

Types of paper	Approx. weights	Approximate total prod., %	Approximate speed range
(a)			
(b)			
(c)			
(d)			
(e)			

3. Number of regulated sections: _____
4. Configuration of machines
   (a) _____ (d) _____ (g) _____ (j) _____
   (b) _____ (e) _____ (h) _____
   (c) _____ (f) _____ (i) _____
5. Age of drive:
6. Designed speed range: _____
7. Scheduled days of production per week: _____
8. Number of machines in mill: _____
9. Number of scheduled maintenance shutdowns per year: _____
10. Number of operating electricians in paper mill: _____
11. General description of maintenance program: _____
12. General description of spare parts maintenance: _____

Machine No. _____ Survey Code No. _____

	Unscheduled lost time, min.								
	S	M	T	W	T	F	S	Total	Remarks
Motors									
Generators									
Rotating amplifier (amplidyne, Rototrol)									
Tachometer generators									
Relay coils									
Relay contacts									
Push buttons									
Tubes (gas)									
Tubes (vacuum)									
Other static regulator components									
Regulator readjustment									
Rheostats and potentiometers									
Wiring or grounds									
Overloads tripping									
Draw variations or swinging from causes unknown but believed caused by drive									
Draw rheostats									
Mechanical components									
Miscellaneous (Please explain in remarks)									
	Weekly Total....								
Scheduled maintenance (man-hours)									
	Weekly Total....								

quantitative records, such as a chemist can keep on an experiment. The very nature of the operation makes exact quantities impossible due to the inability to assign an exact cause for every break on the paper machine. Exact quantities are not necessary for the purpose desired. Rather, we want to know the relative importance of each item and its trend. Most mills do have a monthly figure of electrical lost time with the auxiliary equipment, such as pumps and fans, lumped together with the drive. These figures are taken from the paper mill log and very often do not present the actual causes of trouble and can become a "catch-all" for unknown troubles. An entry in the mill log of "first drier would not start" indicates to the mill the effect of the trouble and is sufficient for them. The electrical department should enter this lost time on their records by the cause, such as, "first drier would not start—contact on CR relay not making."

PRACTICAL USE OF RECORDS

There has been insufficient time to receive enough data on lost time to attempt a thorough analysis. From records that have been used by one mill as a control over their lost time, Fig. 1 shows how the average lost time per month, per machine, has progressed in succeeding 6-month periods for the past 2 years.

A program of detailed records on lost time was started in July, 1951. This graph represents the average of four machines manufacturing kraft paper at an average speed of approximately 1000 to 1600 f.p.m., and one board machine operating at approximately 1000 to 1200 f.p.m. This mill operates 24 hr. a day with four repair shutdowns a year. The outstanding feature of this graph is that the average lost time decreased from 274 min. per machine per month in the July to December, 1951, period, to 101 min. per machine per month in the following 6-month period and has remained at a low level since that time. What has been responsible for this decrease? Figure 4 shows a comparison of the minutes lost time due to various causes during the high lost time period and the average of three low lost time periods. It is obvious from this chart that the decrease in lost time shown in Fig. 1 has been due mainly to a reduction in "draw variation" and "miscellaneous." There are two general reasons for this decrease. First of all, this period reflects an increased effort of the electrical department to control electrical lost time. The records provide a new incentive to improve and a new tool to work with in analyzing trouble. Secondly, there were many items included in the "draw variation" and "miscellaneous" columns that were not electrical and the "draw variation" column was frequently used when the cause of a break was unknown. It is very difficult, in many cases, to determine the actual cause of a break but the more accurate the assignment of the cause can be, the more attention the trouble will receive. Detailed records pointed out that the cause of over half of the lost time charged to the electrical department was undetermined and some of this presumably did not belong to the electrical department. The attention the electric drives were now getting invited accurate assignment of causes of breaks and electrical lost time figures began to take meaning. Only an average of 12% of the electrical lost time is now not explained.

This mill is now in a position to evaluate its electrical drives. Figure 5 shows the distribution of the lost time by cause for the low lost time 18-month period, January, 1952, through June, 1953. There is no one item that is outstandingly high, but rather a general distribution. Let us take a closer look at the largest

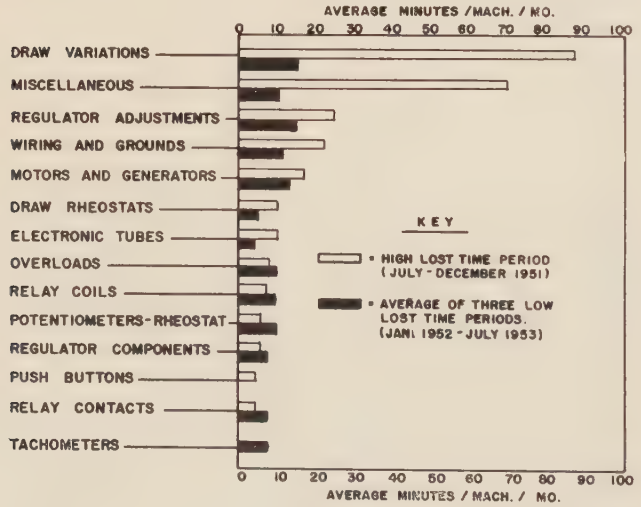

Fig. 4. Paper machine electrical drive lost time by cause on four kraft paper machines and one board machine in the same mill over a 24-month period. (July 1951–July 1953)

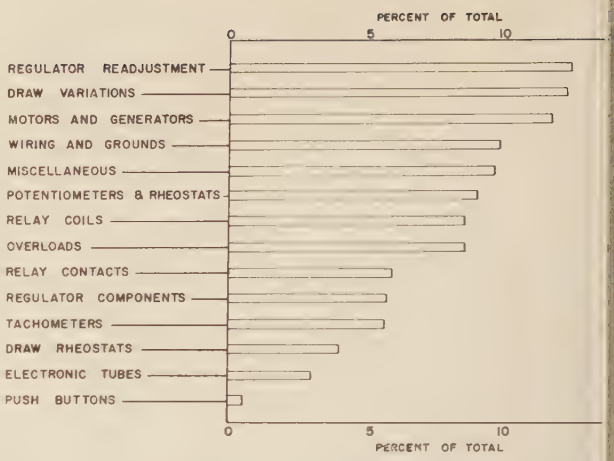

Fig. 5. Distribution of the causes of electrical drive time on four kraft paper machines and one board mach in the same mill over an 18-month period. (January 19 June 1953)

item or "regulator readjustments." The picture is quite clear as yet—is this trouble increasing or creasing? Figure 2 shows the trend of "regula readjustments." It has been increasing steadily the past 18 months and is certainly an item that will more attention. Past records can be reviewed an will be determined just what these adjustments and which one is the most important. The prob can then be studied by the mill electrical departm and can also be referred to the drive manufacturer his suggestions. The results of any corrective st will show up on the next point plotted on the curve.

"Relay and contactor coils" is an average ite What has been its trend? Figure 3 indicates tha was once a more serious problem but has show definite downward trend. This problem was revie in 1951, and a closer control was held on exciter volt Coils were inspected more closely and discarded w they showed signs of deterioration. In any event, concerned have the satisfaction of knowing how mu improvement has been made.

For any mill to get a complete picture of its electri drives it needs three things: (1) the trend of total l time, (2) the distribution of the causes of lost time, a (3) the trend of each individual cause of electrical l time. The one thing these items cannot do is indic how its lost time compares with the rest of the indust This is an important comparison and can only be p sible if there is a common bookkeeping system an common attitude of interest and cooperation betw mills.

Keeping records on drives appears very difficult the start but as more and more data are accumula they begin to take shape and have a meaning. A p son is apt to remember only the troubles encounter during one or two days a month and not temper th with the large number of trouble-free days. An unf lost time charge or a trouble that was never solved c possibly lead one to conclude that records would ne have meaning. A continued record, the author is c vinced, will prove this wrong. The time consumed keeping these records is not great once a procedure established and is certainly time well spent.

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The Maintenance of Bleach Plant Equipment

HAROLD H. HUSEBY

The treatment of several problems in handling chlorine is discussed, along with those problems encountered in maintaining facing on vacuum washers. Ventilation and the elimination of corrosive gases and moisture posed a question and the answers were found in hoods placed directly on each washer. Other maintenance problems are also discussed.

BEFORE going into any detail on the topic, perhaps a brief explanation or description of the bleach plant at The Northwest Paper Co., at Cloquet, Minn., is in order.

The new bleach plant was contructed in 1946 and 1947 and was put into operation early in 1948. Three kinds of pulp are bleached—each through a separate system. One system is a two-stage process consisting of a neutralized chlorination stage and a high density hypochlorite stage. This is on short-fibered kraft or aspen kraft. The sulphite pulp is bleached in three stages: namely, acid chlorination, caustic extraction, and finally, high density hypochlorite. The jack pine kraft process consists of five stages: namely, acid chlorination, neutralized chlorination (Hooker process), caustic extraction, high density hypochlorite, and finally, low density hypochlorite.

All stages of all processes are continuous bleaching, except the last stage of sulphite which ends up as a batch process in old-style Wolf bleachers.

As for raw material, chlorine and caustic are purchased in tank cars and bleach liquor is made up at the plant by the usual process of saturating milk of lime with chlorine gas.

It will not be the intent of this discussion to report on the results of a new development or process, but to review several problems and the answers as of today. Tomorrow, there may be a better answer. Most important, it is not the intent to discredit the product of any manufacturer, but only to relate one plant's experience and the ultimate solution.

Chlorine is brought up from the tank car under pressure to the evaporators. These evaporators are located only a few feet from the bank of flowrators that serve all processes. For the first year or so, considerable trouble was encountered when a black tarry mass periodically stopped up the lines after the evaporators and also the flowrators, causing them to be inaccurate to say the least. A glass wool filter in the liquid line before the evaporator proved ineffective and was soon discarded. In an effort to trap out this tarry mass, a 6-in. pipe 6 ft., long was mounted vertically in the line after the evaporators and just before the flowrators. The chlorine enters the top of this pipe, passes around a short baffle, and leaves through the top again. This expansion drops out much of the objectionable tarry mass. A by-pass around this trap allows it to be taken out of service during operation for draining and cleaning. This is done once a month, netting enough objectionable material to make it really worth while.

It seems that as long as chlorine is kept in a liquid state, whatever small amount of impurities are in it or are picked up by it, will be carried along without any trouble. After the chlorine has been evaporated, this material is apt to accumulate in some pocket. Then, if the evaporator fails, or if the gas is allowed to cool off before passing through the flowrators, the gas will return to a liquid state and will pick up this tarry mass and carry it into the flowrators. Two practices have been adopted to combat this. First, the chlorine is not brought up to the flowrators until at least one of the systems is ready to receive it. Second, the room where the flowrators are located is kept warm at all times. These precautions have kept flowrator trouble at a minimum.

Teflon packing has been the answer on chlorine valves. Before using this packing, the plant was continually troubled with leaking and sticking valves. Opening these valves required extension levers on the valve handles. This leverage, when applied on closing, scored the valve seat to start a troublesome leak. Since using Teflon operators have not damaged one valve and are never troubled with leaks. All valves are removed twice a year, cleaned and checked, and the same packing used again. Incidentally, Teflon packing need occupy only about one fourth to one third of the packing gland. The rest can be made up of a metal sleeve or another packing.

Milk of lime is used for pH control on the second kraft stage. It is fed into the process through a $^1/_2$-in. automatically controlled valve. Several styles and makes of valves were tried and failed. Some plugged easily from the flakes that seemed to leave the side of the pipe at times, and others wore out from the abrasive action of the lime. This problem was solved by using a pinch tube valve. This valve is nothing more than a 6-in. piece of ordinary $^1/_2$-in. water hose, using an air head for closure. This rubber tube has to be replaced about once a month, but this job takes only 15 min.

All stock washing in the bleach plant is accomplished over vacuum washers. Keeping facings on these washers presented a problem. A metal could not be found to weld the facing seam that would stand up under the severe acid conditions on some of the washers. Several facings were also lost when the washer plugged up. Welding the seam was finally abandoned in favor of a 1-in. lapped seam and then holding the facing on with $^1/_2$-in. stainless bands placed 1 ft. apart across the length of the facing. These bands are 20 thousandths of an inch thick and are fastened by a clip. This method makes it necessary to keep the take-off roll a minimum of 150 thousandths of an inch away from the cylinder which has not reduced the effectiveness of the take-off roll on long fibered pulp, but has caused some

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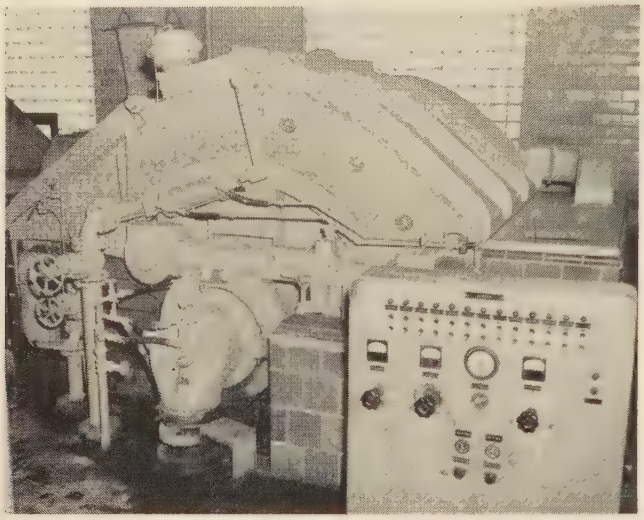

Fig. 1. Vacuum washer showing hood closed

difficulty on aspen kraft. Just recently, the writer was informed by a representative of the vacuum washer manufacturer that they now have perfected a jig and the technique to spot weld the bands, thereby eliminating the clip. This makes it possible to move the take-off roll to within 45 thousandths of an inch from the cylinder and thus be much more effective on short-fibered pulp. Washer plug-ups have been experienced that the author knows would have torn the facing from the cylinder except for the protection afforded by these bands. One might add up the total area occupied by these bands on the facing of the washer and say that the washing efficiency would suffer, but it is doubted if it could be measured.

Preventive maintenance hardly needs any emphasis. However, a method of application may deserve a little attention. A file is kept on each piece of equipment that requires lubrication. This file is in charge of the maintenance file clerk who writes an order to the proper millwright when an oil or grease change is due. When the change has been completed, the order is signed by the millwright and returned to the file clerk who checks it off on the files with any comments made by the millwright. However, this is not enough. Any moving part that is wearing out can be detected by seeing, feeling, smelling, or hearing. So, if you are not blessed with an oiler or a millwright who will instinctively use all these senses as he makes his rounds through the plant, every effort should be used to build up this quality in the maintenance force. Certainly any suggestion made by a maintenance man should be given full consideration or you will soon find him failing to report those little things that will grow into a major repair job.

The proper lubricant for the job is important. Skilled representatives from a major oil company surveyed the plant not only to recommend the proper lubricant but possibly to cut down on the number of different kinds and grades with a resulting lowering of lubricant inventory.

Safety definitely has its place in maintenance as well as in operation. In modern bleach plants where most or all of the bleaching is accomplished in a continuous operation and the various pieces of equipment are tied in in a sequence, an added danger of starting a machine while under repair is encountered. The only sure c then, is to provide each maintenance man with a loc be placed on the starter for any equipment he is w ing on, and he only is to remove this lock. This ide expanded to allow for two crews. For instance, w the millwright finishes setting a motor, he removes lock and the power cannot be turned on until the e trician has finished his wiring and has also removed lock.

Identifying all pipe lines as to what they are carry and from what piece of equipment makes many re jobs move faster. Having the maintenance crew the checking and the labeling of these pipes will m them more familiar with the process.

The writer has nothing to offer on instrument ma tenance except to point out that a wise decision made when designing the plant to group all the recor in the control room. This room is kept under press using activated carbon filters to eliminate any corro gases from the air. It is felt that these precise inst ments would have suffered a great deal if exposed to conditions out in the plant, especially before the ho were put on the washers.

The washers came equipped with plastic hoods t had to be opened by sliding each section in groove its supports. These hoods soon became ineffective the plastic fogged up and the operation of the was could not be checked without sliding each section op The sections soon would not slide as the grooves w full of stock. The hoods were removed and the pl was operated for several years without this needed p tection, resulting in excessive deterioration of equ ment and structural steel. Investigation was mad several different kinds of hoods, including a comm hood over each line of washers. It was found that e when an excessive amount of air was pulled through hoods there were still puffs from the washer that all chlorine gas and moisture to escape out into the ro A tight fitting hood mounted on each washer seeme be the answer, but it would have to be one that coul opened conveniently to inspect the washer operat and could be opened fast in case of trouble on washer. The design arrived at is made in two secti and each section swings open on a shaft on the t A lever off this shaft is connected to the piston of an

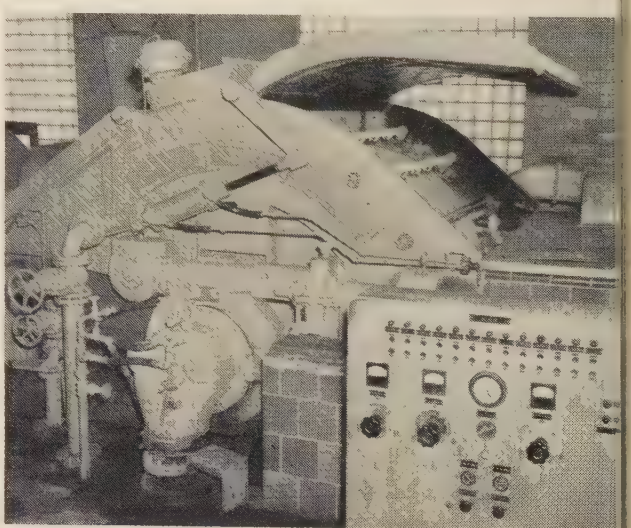

Fig. 2. Vacuum washer showing hood open

cylinder mounted on the side of the washer. By opening a conveniently located air valve, the cylinder is actuated and swings the hood open. Routine inspections are made easy. The cover over the entrance section of the washer is rigid and from this a duct is taken to a fan that exhausts the air from the washer to the roof. Ordinary black iron was used for the frame of these hoods and Uscolite was used as the sheeting. This sheeting was held to the frame by rivets which are also made of Uscolite.

Seven hundred cubic feet of air are pulled through each washer and it is more than adequate to remove all traces of any gas or moisture coming off the washer. It is estimated that a minimum of 3000 cu. ft. of air per min. per washer would be required if a common hood was used over a line of three or four washers. This represents a substantial saving in steam to heat the building.

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Identification of Wet-Strength Resins in Paper by a Dye Staining Technique

R. R. HOUSE and N. T. WOODBERRY

Because of the increased use of wet-strength resins in the paper industry during the past 10 years, it has become important to have a quick and accurate means of identification for these resin-treated papers. Several years ago a dye staining technique was developed, the use of which made it possible to identify most wet-strength papers. Recently, however, new types of urea resins have become commercially available and it was found necessary to modify the dye staining test to cover these resins. A blue acid dye is employed which is selectively adsorbed by the various resins (urea and melamine) and various protein materials (glue, casein, etc.) which may be found in wet-strength papers. By use of several pretreatments and dyeing procedures, it is possible to positively identify paper treated with a melamine resin. The test may also be used to identify some types of urea resins while supplementary tests may be necessary to help differentiate between other types of urea resins and protein materials.

The past 15 years have witnessed a marked increase in the production of wet-strength papers, with special emphasis on the use of melamine-formaldehyde and urea-formaldehyde resins. With their use, the paper mill chemist has been faced frequently with the problem of identifying these resins in waste paper used as raw material or even unidentified broke from his own mill. In the identification procedures described by Stafford (*1*) and co-workers, a dye staining technique was described in detail for the identification of melamine wet-strength resin samples in the presence of samples containing urea-formaldehyde resins as well as other wet-strength agents. Since the publication of this dye staining procedure, there has appeared in commercial quantities paper containing cationic urea resins which react to the test dye to the same degree as melamine treated papers. The purpose of this article is to describe a revised method by which it will be possible to identify paper containing melamine resins from paper containing any of the urea resins or other wet-strength agents. This method may also be used to distinguish between certain types of urea resins especially when used in conjunction with various chemical analyses.

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Although the revised method is quite useful for laboratory evaluation, it is not the ultimate rapid control procedure desired by the waste paper industry and others; however, it certainly should assist anyone handling wet-strength broke in identifying wet-strength treatments.

CONCEPT OF TEST

This test is based upon the fact that acid dyestuffs are not substantive to cellulose, and unless mordanted, can easily be washed from cellulose fibers. On the other hand, the acid dyes combine with "proteinlike" substances such as wool, glue, casein, and amino-aldehyde resins. One of these acid dyes, Calcocid® Alizarine Blue S.A.P.G.,* has been chosen as being particularly useful for the present purpose. By use of this dye under specified conditions, untreated paper can be quickly distinguished from paper containing materials such as proteins, urea resins, or melamine resins. By using three different modifications of the same technique, applied to separate portions of the unknown sample, it is generally possible to decide whether or not melamine is present or to obtain indications as to the nature of the other nitrogen-containing substances if melamine is not present.

The detailed procedures for performing the tests are as follows:

Stock Solutions

Solution A—A 1% solution of NaOH (0.25 *N*).

Solution B—A 0.1% solution of Calcocid Alizarine Blue S.A.P.G., containing 0.1% H_2SO_4.

Solution C—A 0.1% solution of Calcocid Alizarine Blue S.A.P.G., containing 1.0% H_2SO_4.

Solution D—A 2.0% solution of H_2SO_4 (about 0.4 *N*).

Preparation of Paper Samples

Samples of uniform size (a square 1.5 in. on a side is convenient) are cut from each unknown sample being tested and marked. A piece of known untreated paper

* Manufactured by American Cyanamid Co.

Table I. Dye Staining Results

Wet-strength additives present	*Color of treated paper*			
	Procedure I	*Procedure II*		*Procedure III*
		Acid pretreatment (A)	*No pretreatment (B)*	
Melamine resin	Blue	More intense blue (Sample A same as B)	More intense blue	Same as II
Urea resin				
Usual anionic and cationic types	Blue	Colorless	Less intense blue, or colorless	Same as II (sa may be defibere
Special cationic types[a]	Blue	Blue (Sample A less intense blue than B)	More intense blue	Same as II
Protein				
Glue	Blue (mottled effect)	Colorless	Less intense blue, or colorless	Same as II (sa may be defibere
Casein	Blue	Blue-intensity variable	Blue-intensity variable	Colorless
None	Colorless[b]	Colorless	Colorless	Colorless

[a] Uformite 700 and 711 are in this class.
[b] A sheet containing alum and rosin size may show a faint blue coloration.

also should be included with the test samples in order to make certain that the dye held on any paper sample is due to a "proteinlike" substance. This "known" or control sample should, if possible, be of a type similar to that of the sample being tested, except that wet-strength additives should not be present. More important, the control should be similar in color to the sample being tested.

Dyeing Procedures

Procedure I. Use 200 ml. of solution B (0.1% Calcocid Alizarine Blue S.A.P.G., 0.1% H_2SO_4) for every gram of paper. Dye the samples (including the control sample) for 5 min. at room temperature in the bath, which should be stirred frequently to prevent the samples from sticking to each other. The samples are then washed in three 500-ml. portions of cold water or until the control sample is free of any surface adsorbed dye. In the case of very hard sized, surface treated or highly calendered paper (such as tab stock, etc.) it may be necessary to wet the sample by adding a small amount of a nonionic wetting agent (such as Triton X-100) to the dye solution.

A blue coloration obtained by use of procedure I indicates the presence of a "proteinlike" substance.

Procedure II. Cut two samples from the unknown, label A and B. (1) Pretreat sample A using 200 ml. of solution D (2% H_2SO_4) for every gram of paper for 5 min. at the boil. (2) Use 200 ml. of solution C (0.1% Calcocid Alizarine Blue S.A.P.G., 1.0% H_2SO_4) for every gram of paper. Dye sample A and B (including a control sample or blank) for 5 min. at the boil. The samples are then washed in three 500-ml. portions of cold water or until the control sample is free of any surface adsorbed dye.

A considerable difference in blue color (and wet strength) between samples A and B indicates the presence of a urea-formaldehyde resin or a protein in some instances. Little or no difference in blue color (and wet strength) indicates the presence of a substance resistant to hydrolysis (e.g., melamine resin). Apparently the hot acid pretreatment partially or completely hydrolyzes the urea-formaldehyde resin or glue but has little effect on the more resistant melamine resin. In many cases, paper treated with glue or a urea wet-strength resin will lose all wet strength, even to the point of disintegration, in the hot acid pretreatment. In general, it has been found that the pretreatment (boiling the paper for 5 min. in 2% H_2SO_4) in procedure II is sufficient to distinguish between the urea and the melamine wet-strength papers. For heavier papers and boards and those containing an unusually large amount of some urea formaldehyde wet-strength resins, this time may be increased to 10 min. with little effect on the melamine resin.

It will be noted that in the case of the melamine resin treated papers, the blue color resulting from proce II is much more intense than that obtained in the dye solution of procedure I. The higher tempera and acid concentration of procedure II increase rate of diffusion of the dyestuff so that the sam containing a substance resistant to hydrolysis (melamine resin) show an increase in the amount of picked up.

Procedure III. Pretreat the samples using 200 ml. of solu A (1% NaOH) for every gram of paper for 5 min. at the Rinse the samples carefully in three 500-ml. portions of water, and then perform the dye test as described in "proce II."

The pretreatment included in procedure III remo most of the nitrogenous substances likely to be pre in wet-strength paper, except melamine resins and s types of urea resins. Certain formaldehyde harde casein coated papers also may be resistant to alkali pretreatment but can be removed with hig concentrations (2 to 3%) of hot alkali. In develo the three specific dyeing procedures described al the dyebath to paper ratio and time of treatmen procedures I and III were chosen arbitrarily. further experience is gained, it is quite possible t modifications of these conditions may be found c venient.

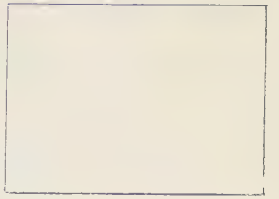
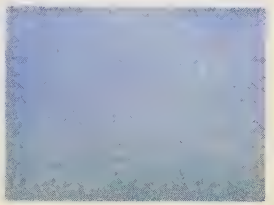
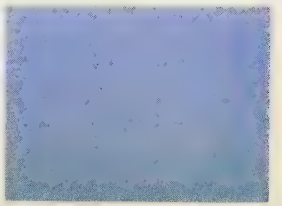
INTERPRETATION OF RESULTS

Good results in differentiating among the var additives that may be present in wet-strength pa often can be obtained by use of the dyeing proced just described. However, it may be preferable supplement the dye test results with other data be drawing final conclusions. This is particularly t in view of the wide variety of wet-strength agents u in the past, and of the possibility that new mater will be encountered at any time.

A summary of the coloring effects obtained up application of the specified dyeing procedures, various types of wet-strength paper, is shown in Ta I and the color chart. Before applying the dye tes unknown samples, it is suggested that known samp be treated according to the procedures described a the results compared with those shown in the table a the chart. The color chart is useful as a guide bu should not be relied on for direct comparisons of known samples. The amount and nature of the re present and the color of the paper itself can affect intensity or shade of the final colors.

By inspection of Table I and the color chart, it

PROCEDURE

	I COLD DYE	II A HOT ACID PRETREATMENT + HOT DYE	II B HOT DYE	III HOT ALKALI PRETREATMENT + HOT DYE
MELAMINE RESIN				
UREA RESIN (SPECIAL)				
UREA RESIN (USUAL)				
GLUE				
CASEIN				

evident that the speed of conducting the test depends upon the number of dyeing procedures that are used. This, in turn, is dependent upon the amount of information already available concerning the sample, and upon the scope of additional information desired. For example, the following specific cases illustrate some of the possible variations in approach:

Example 1—If a sheet containing urea resin, melamine resin, or a protein is to be differentiated from an untreated sheet, use "procedure I." A blue coloration indicates that one (or more) of the above types of additive is present.

Example 2—If urea resin and melamine resin are known to be the only two additives present in a group of papers (not a combination of the two resins in one sheet), the treatments may be differentiated from one another by performing "procedure II." The sheets containing melamine resin would show no color change between samples A and B, while the sheets containing urea resin would show a decrease in blue color (if any color at all) between samples A and B.

Example 3—If melamine resin treated paper is known to be present along with protein treated paper (both materials not present in one sheet), for a quick test perform "procedure III." The melamine resin treated samples would show an intense blue color whereas the others would possess only a faint blue color, if any. However, should the amount of resin present in a sheet be quite small, only a light blue color would be obtained and doubt raised as to the meaning of the test. In such case, "procedure II" should be performed on another set of samples. The presence of melamine resin in a sample would be substantiated if all pieces showed the same intensity of color.

In many cases specific data concerning the samples may not be available, and then, of course, all three dyeing procedures should be applied. It will be noted that the technique as described is specific so far as indicating whether or not melamine resin is present. If, however, melamine resin and some other material, such as urea resin or a protein, are present in the same sheet, the dyeing tests may not show the specific nature of the second constituent. It would then be necessary to rely upon some other type of test to obtain such information. This is now possible by means of ultraviolet spectrophotometry. Hirt, *et al.* (*2*) have been able to detect quantitatively very small amounts of melamine even in the presence of other nitrogeneous types of material.

The "dye test" as described has been applied to a variety of "known" samples, with surprisingly good results to date. In only one type of paper has an apparent discrepancy been observed. This type of paper was a casein coated paper which had been hardened with an excess of formaldehyde in the laboratory. Upon application of dyeing "procedures II and III" to separate pieces, it was found that there was little difference in the intensity of the blue color developed. However it was demonstrated that the casein coating could be removed by increasing the concentration of the hot caustic pretreatment of procedure III from 1 to 3%.

Obviously, the dyeing technique would not be used for testing deeply colored beater dyed papers. Also, difficulty might be found in testing unbleached kraft papers containing very small amounts of resin.

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The Flat Screen versus the Ahlfors Screen for Bleachable Pine and Hardwood Sulphate Pulp

ROY HOMANS and MALCOLM B. PINEO

A high density screening system using an Ahlfors screen was installed on a trial basis, but it was not too successful because of variation in consistency. Under proper control it would appear that a high density screening would have the following advantages: (1) high production rate per unit of screening area, (2) satisfactory separation of fiber and dirt, (3) lower capital cost, (4) decreased decker capacity, (5) possible operating man-hour savings, and (6) possible reduction in maintenance cost with a decrease in screening area.

The kraft mill producing high quality bleached pulp has always been troubled with the efficient removal of unbleachable material such as shives, bark, and system dirt. The use of flat screens for this job has been commonplace and the results have been highly satisfactory. However, a flat screen installation requires a substantial capital investment and maintenance costs are worthy of note. It is not practical to consider less than one screen plate per daily ton of production and to attain this capacity rating the flat screen operation has to approach perfection. The allocation of sufficient floor space is often difficult and the auxiliaries such as pumps, deckers, flow boxes, etc. must be designed to handle low consistency screening, For instance, a 500-ton per day mill, bleaching southern pine kraft pulp will require approximately 1500 sq. ft. of screen room floor space. On the basis of 0.8 ton per day, approximately 40 sections of 14 plates each will be needed for processing this tonnage, and pumping and deckering capacities of 15,000 to 20,000 g.p.m. are required. Such an installation purchased today, will demand $1^1/_2$ to 2 millions of dollars of capital investment. Operating costs, exclusive of depreciation, will amount to 80¢ to $1.00 per ton of pulp produced.

It would seem that the aforementioned burden of capital investment and operating cost for a full flat screen installation could be substantially reduced.

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Table I. Trials of Varying Headbox Level

Series	*Headbox level, in.*	*Reject level, in.*	*Rejects, %*	*Accepted % moisture-free consistency*	*Accepted moisture-free tons/day*
1	10	6	0.7	1.42	25.4
	12	7	0.7	1.38	25.5
	14	7 1/4	4.0	1.37	26.8
	18	10 1/4	11.6	1.37	26.5
2	17	8	1.4	0.85	27.0
	25	13	4.5	1.01	27.4
3	21	10	4.3	0.85	24.7
	28	15	5.7	0.88	24.8
4	22	11	6.4	0.80	28.0
	25	15	5.6	0.87	29.5

Conditions: pine pulp; input shaft 1300 r.p.m.; 4 weights on eccentrics; 12-cut plates; headbox levels as noted.

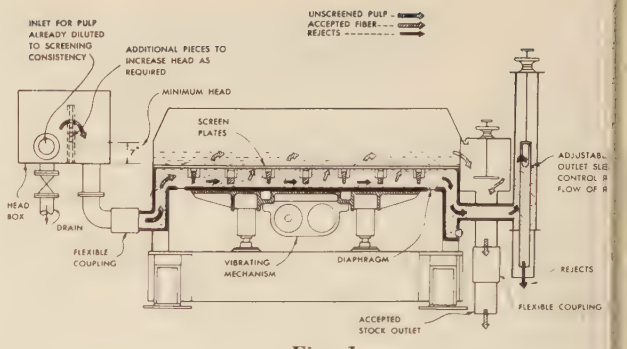

Fig. 1

The key factor is screening consistency. If the consistency can be increased, it would appear that the demand for capital would be reduced through a reduction in floor space requirements, less deckering and pumping capacities, lower over-all operating costs for maintenance, labor, power, etc. The unknown, of course, hinges on the selectivity with which the undesirable material is separated from the acceptable stock and the rate with which this operation is accomplished. It is with these conditions in mind that the following investigation was made.

Although the Oliver-Ahlfors upflow vibrating pulp screen is only one of several units designed for high consistency screening, this particular unit was available and was deemed suitable to establish the advantages or disadvantages of high density screening. It was proposed that the Ahlfors screen, as the unit will be identified in this report, would effectively separate the undesirable shives and dirt at relatively high consistencies and would establish capacity ratings as compared with the conventional flat screens. A cutaway view is shown in Fig. 1.

A new approach to screening is introduced by the Ahlfors screen. In place of flowing the stock suspension across the top of the screen plate and promoting the rejection of oversized particles by removing the acceptable fibers, the stock suspension is introduced into the space below the screen plate and the acceptable fibers are forced upward through the screening slots. The oversize or objectionable material remains under the plate and is removed by way of an adjustable dam. The upward flow of stock through the screen plates is brought about by the hydraulic head created by the position of the dam in the reject box and the baffle arrangement in the headbox. The level differential controls the rate of flow through the screen. This arrangement maintains a constant pressure across the entire width of the screening area and eliminates dry screen plates. Thus the screen plates are submerged at all times, permitting an uninterrupted flow of accepta fiber through the screen slots. The rejected mate passes through the lower compartment of the scr and is discharged over the adjustable reject out Unlike the conventional flat screens, the concentrat of bark, shives, and system dirt is held at a minim in the Ahlfors unit. Although there is a definite crease in concentration of this objectionable mater it never reaches the maximum encountered at the re end of a flat screen where the flow must be contro at a minimum to prevent loss of acceptable stc The volume of fluid containing the rejects can ne approach zero in the Ahlfors due to the differen head holding the screening compartment full. E though the reject dam is raised to establish a no-f condition, the rejects never pile up on the screen pl and enter the stream of acceptable stock.

Another feature of the Ahlfors screen, which is to its high capacity per unit of screening area, is automatic cleaning shower. This shower oscil across the screening area on a predetermined time cy Whereas, the upflow principle moves the fibers upw through the slot and countercurrent cleaning is m possible. The cleaning of the conventional flat scre must be done from the screening side of the pla It would be expected that a better cleaning job ca accomplished without forcing any of the accumula objectional dirt and shives into the accepted st stream.

Because the Ahlfors unit handles stock suspension higher consistencies than is normally supplied for scre ing with the conventional flat screens, and the flow principle should lend itself to more effective se ration of acceptable fibers and rejects, and the den differences between single cellulose fibers and shi dirt, bark, etc. will effect a natural separation as flow of stock progresses across the screening area,

Table IIA. Relationship Between Consistency and Rate (Pine)

Number of tests	*Average consistency, %*	*Average tons/day*
1	0.68	23.1
5	0.75	24.4
11	0.85	26.9
15	0.92	25.9
10	1.03	26.7
9	1.14	24.7
2	1.21	26.5
5	1.33	26.7
2	1.55	25.8

Conditions: pine pulp; input shaft 1300 r.p.m.; 4 weights on eccentrics; 12-cut plates; headbox levels 17–21 in.

Table IIB. Relationship Between Consistency and R (Hardwood)

Number of tests	*Average consistency, %*	*Average tons/day*
1	1.39	48.9
3	1.42	44.2
1	1.57	48.0
4	1.65	45.1
2	1.75	44.5

Conditions: hardwood pulp; input shaft 1300 r.p.m.; 4 weight eccentries; 12-cut plates; headbox levels 17–21 in.

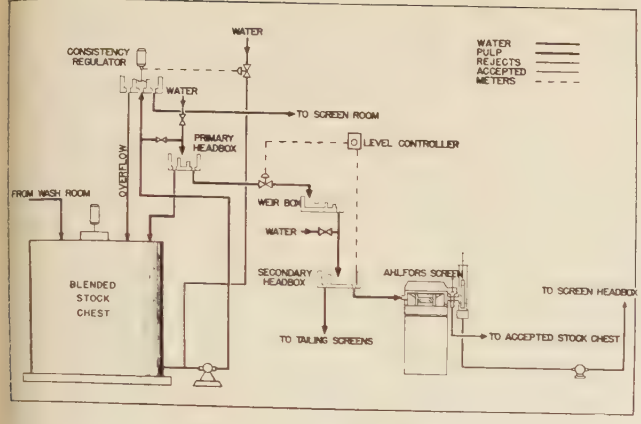

Fig. 2. Flow diagram

the traveling shower cleans from the accepted stock side of the screen plates and forces the rejects back into the reject stream, it was assumed that the following conditions would exist: (1) screening capacity would be higher per plate, (2) better selectivity would be effected, and (3) less acceptable stock would be present in the reject outlet. These are the factors for which an answer was sought.

PROCEDURES

Figure 2 presents a schematic flow diagram of the experimental system used to evaluate the qualifications of the Ahlfors screen. Controlled consistency stock, at approximately $2^1/_2\%$, was drawn from the blending stock storage chest feeding the fan pump to the existing screen room. A connection to the line feeding the consistency regulator from the blending chest pump was used to convey regulated stock to a primary headbox. Fresh water was added to this pulp as it entered the primary headbox with the overflow going back to the blending tank.

For stock flow control an automatic stock regulating valve was placed in the line between the primary headbox and the measuring weir box. The flow of stock to the weir box was controlled through the automatic valve by the level in the secondary headbox. The weir box, equipped with a 60° V-notch weir, and adequately baffled, allowed the measurement of stock flow and consistency. As is shown in Fig. 2 the stock from the weir box was discharged into the secondary headbox. As mentioned about the level in the secondary headbox determined the position of the automatic stock control valve and the volume of stock passing over the measuring weir. Records were kept of the flow over the weir, the consistency of the stock, and the level of the secondary headbox, from which accurate flow measurements were determined. If it became desirable to lower the consistency of the stock to the screen

Table III. Trial of Varying Speed of Input Shaft

Input shaft, r.p.m.	*Headbox level, in.*	*Reject level, in.*	*Rejects, %*	*Accepted % moisture-free consistency*	*Accepted moisture-free tons/day*
1300	21	$10^1/_2$	11.3	0.95	28.9
1420	20	$9^1/_2$	6.1	1.05	34.2
1420	20	$10^1/_2$	3.3	1.08	34.7

Conditions: pine pulp; input shaft speed as noted; 4 weights on eccentrics; 12-cut plates.

Table IV. Trial with Hot Water

Temperature, °F.	*Headbox level, in.*	*Reject level, in.*	*Rejects, %*	*Accepted % moisture-free consistency*	*Accepted moisture-free tons/day*
78	21	12	10.2	1.01	23.8
110	21	$12^1/_2$	7.8	1.16	29.8
118	21	12	8.2	1.06	28.2
118	21	11	9.6	1.27	31.1
118	21	11	0.7	1.00	28.8

Conditions: pine pulp; input shaft 1300 r.p.m.; 4 weights on eccentrics; 12-cut plates.

during start-ups and shutdowns fresh water was added to the stock after it passed over the weir and before it entered the secondary headbox.

The Ahlfors screen along with the primary and secondary headboxes, the weir box, and the reject pump was located in the present screen room adjacent to the conventional flat screens. All flows were by gravity with the exception of the return of the rejects to the system by way of the reject pump and conventional tailing screens. A flexible hose was used to transfer the stock from the secondary headbox to the Ahlfors screen. The acceptable pulp was flowed by gravity to a primary line of flat screens through a slotted steel pipe from which consistency samples could be procured.

The rejects from the Ahlfors screen were pumped to the tailing screen headbox of the flat screen system. The rate of reject flow was controlled by the heighth of the adjustable reject tube. The amount of flow was determined by the time required to fill a measured volume, in this case a 3-gal. bucket, and consistencies were measured by sampling the collected discharge. The total weight of rejected material was calculated from the discharge volume per unit of time and its consistency.

In the hopes of correlating the performance of the Ahlfors screen in relation to capacity and cleanliness, a record of the cleaning shower cycle and the shower water pressure was made.

For comparing the results of screening unbleached kraft pulp with the Ahlfors unit to those with the conventional flat screens, comprehensive data were collected for the flat screen operation. Flat screen headbox consistencies established the density of the stock to the screen. Consistencies of stock to the screen room deckers determined the accepted stock densities and the flow of stock to the bleach plant was used for capacity ratings. The volume of rejects was measured by means of weighing the discharge from the tailing screens and computing the pounds rejected by determining their moisture content.

The capacity for each section of flat screens, in terms of oven-dry stock per day, was established by dividing the sections in service by the total tons produced. Consideration was given to stock inventory changes and the rate of flow to the bleach plant was correlated with total tonnage from the pulp drying machines. Shrinkage factors through bleaching were estimated.

No data are reported for the shakedown period. Periods of uniform operations were used for all comparative runs. Particular attention was given to uniform rates of flow, degree of delignification as measured by the permanganate number, cupriethylenediamine viscosity, water balance, and other factors affecting screen room operation. The data as included in the following

Table VA. Changing Weights on Eccentrics (Pine)

Number of weights	Level, in.		Accepted		Shives/g.		Dirt count	
	Headbox	Rejects	Moisture-free consistency, %	Moisture-free tons/day	Flat screen	Ahlfors	Flat screen	Ahlfors
2	20	10	0.95	24.4	..	..	..	..
2	20	11	0.98	23.7	24	28	0.46	0.62
4	21	9 1/2	1.02	25.6	18	13	0.32	0.24
4	20	11	0.94	24.8	..	..	..	..

Conditions: pine pulp; input shaft speed 1300 r.p.m.; weights on eccentrics as noted; 12-cut plates; headbox levels as noted.

tables are averages of tabulated data with all pertinent related conditions tabulated at the bottom of the table.

DISCUSSION OF DATA

The installation of the Ahlfors screen was completed on Oct. 30, 1952. It was finally dismantled and returned to the supplier in early May, 1953. During this trial period many short runs of several hours or several days were made as well as one uninterrupted period of 34 days. Most of the data submitted were collected during this latter period.

Mechanically, the Ahlfors screen presented some problems. Several broken plates were found, necessitating a redesign of the original units. The change in plate design incorporated greater strength across the ends and around the holes. It is felt that the new design would permit satisfactory plate service.

Further mechanical failures were encountered in the diaphragm and diaphragm support. However, it must be remembered that the conditions of speed, consistency and diaphragm pulsation were not consistent with the manufacturer's recommendations. Spring failures were also found but here again it must be pointed out that the unit was not "babied" and extreme operating conditions were used in many of the trial runs.

Table I presents a series of four tests showing the effect of varying headbox levels. The scope of this study was limited by the design of the reject level tube which would not permit a height greater than 15 in. However, for any one series of tests, it can be seen that changes in the headbox level did not materia increase the production of acceptable stock thro the screen but did increase the amount leaving by v of the reject outlet. The differences among the f series presented are attributed to the changes in screening characteristics of the stock being run at time of the test.

Table IIA shows the relationship between inlet c sistency and screening capacity for unbleached p pulp. These data were assembled from many gro of spot tests and listed in terms of group averages related to consistency. Although constant headb levels were not maintained, the limits were chosen tween 17 and 21 in. It can readily be seen that production of acceptable stock remained relativ constant over a wide range of input stock consistenc

Table VB. Changing Weights on Eccentrics (Pine)

Number of weights	Level, in.		Blinding consistency, %	Accepted		Shives/g.		Dirt count		Average hp./ton
	Headbox	Rejects		Moisture-free consistency, %	Moisture-free tons/day	Flat screen	Ahlfors	Flat screen	Ahlfors	
2	20	12	..	0.60	15.7	..	31	..	0.97	..
2	20	12	..	0.57	16.4	28	21	1.17	0.52	6.68
2	20	14	0.82	0.60	15.4	..	..	..	..	..
4	21	11	..	0.73	20.8	24	..	0.32	..	..
4	21	11	..	0.78	20.0	..	25	..	0.12	6.50
4	20	12	1.20	0.98	20.4	..	36	..	0.06	..
6	20	10	..	0.63	23.2	..	27	..	0.24	..
6	20	12	..	0.92	24.0	..	..	..	..	6.00
6	20	10	1.25	0.83	21.0	22	19	0.38	0.53	..

Conditions: pine pulp; input shaft speed 1300 r.p.m.; weights on eccentrics as noted; 10-cut plates; headbox levels as noted.

It is not unreasonable to suppose that the variati which do exist in the tonnage ratio is a reflection of hardness of the stock rather than any other varia It was established early in the investigation that o mum consistency fell in the range of 0.8 to 1. moisture-free stock. If the consistency fell be 0.8% then the screening rate dropped off proportiona while inlet consistencies above 1.3% gave a defi impression of overloading. Also, as screening c sistencies were increased to 1.5% and above, the scr refused to function at all and production rates drop to zero. Therefore, between the consistency ra of 0.8 to 1.2% moisture-free fiber it can be said that Ahlfors screen will produce approximately 26 moistu

Table VC. Changing Weights on Eccentrics (Hardwoods)

Number of weights	Level, in.		Blinding consistency, %	Accepted		Shives/g.		Dirt count		Average hp./ton
	Headbox	Rejects		Moisture-free consistency, %	Moisture-free tons/day	Flat screen	Ahlfors	Flat screen	Ahlfors	
2	20	13	..	1.20	33.6	..	51	..	0.46	..
2	20	13	..	1.10	29.2	67	64	0.92	0.93	3.73
2	19	13	1.25	0.95	28.6	..	..	..	..	..
4	19	12	..	1.05	37.7	..	105	..	1.27	..
4	19	13	..	1.12	34.0	..	..	..	..	3.55
4	20	13	1.25	1.02	33.1	85	46	1.37	1.74	..
6	20	10	..	1.32	44.5	..	28	..	0.45	..
6	20	10	..	1.30	43.3	25	..	0.50	..	3.13
6	19	10	1.81	1.50	42.7	..	35	..	0.23	..

Conditions: hardwood pulp; input shaft speed 1300 r.p.m.; weights on eccentrics as noted; 10-cut plates; headbox levels as noted.

Table VIA. Comparison Between Ahlfors and Flat Screens Based Upon Average Tests (Pine)

Ahlfors, % moisture-free consistency	0.97	0.86	..
Ahlfors, moisture-free tons/day	25.3	27.1	..
Total section of flat screens run[a]	28	31	32
Decker, % moisture-free consistency	0.47	0.51	0.47
Flat screen headbox, % moisture-free consistency	0.53	0.58	0.59
Flat screens, moisture-free tons/day/section[a]	14.6	13.7	13.9
Bleach plant rate, moisture-free tons/day	435	450	440
Bleach plant, Cl_2 No.	9.4	9.0	8.8
Bleach plant, B.S. viscosity	23.3	22.7	22.4
Bleach plant, B.S. % moisture-free consistency	3.58	3.45	3.48
Water removal by deckers, g.p.m.	13,600	13,150	13,750
Power requirements (av. hp./ton), Ahlfors	..	4.4	..
Power requirements (av. hp./ton), flat screens	..	3.6	..
Shives/gram, Ahlfors	9	14	..
Shives/gram, flat screens	12	12	..
Dirt count, Ahlfors	0.24	0.36	..
Dirt count, flat screens	0.40	0.39	..

Conditions: pine pulp; input shaft speed of Ahlfors 1300 r.p.m.; 4 weights on eccentrics of Ahlfors; 12-cut plates.
[a] Calculated on basis of first two sections of each tailing screen being effective.

free tons of acceptable pine pulp per day under the conditions outlined in Table IIA.

The capacity data for hardwood pulp are shown in Table IIB. The consistency range over which these capacity ratings were established is not wide but enough information was gathered to indicate strongly that consistencies in excess of 1.80% caused partial plugging of the screen and reduced the output of screened stock. The data will support the operation at 1.50% consistency for a daily production of 45 air dry tons of bleachable hardwood pulp per day.

The service engineers recommend the operation of the Ahlfors screen at 1300 r.p.m. of the input shaft. However, the accepted tonnage rates at 26 tons per day of pine pulp and 45 tons per day of hardwood pulp were somewhat disappointing and the decision was made to increase the input shaft speed from 1300 r.p.m. to 1420 r.p.m. Therefore, the data presented in Table III show the relationship between the input shaft speed and the production of acceptable pulp. It should also be noted that the total stock supplying to the screen was not substantially different. The increase in screening capacity was the result of a decrease in the amount of rejects. Stock consistencies and differential heads were maintained as constant as possible. It is sufficient to say that an increase in screened stock per day was brought about by an increase of the input shaft speed. The magnitude of this increased capacity was approximately 18%. Bleachable pine brown stock was used throughout this phase of the investigation.

Another attempt to increase the production of acceptable stock through the Ahlfors screen was to use higher temperatures of the incoming pulp slurry. Table IV shows the results of these trials. At 78°F. operating at a hydraulic head differential of 9 in. the screen passed 23.8 moisture-free tons of stock per day while rejecting slightly over 10% of the stock entering. By raising the temperature from 78 to 118°F. it was possible to increase the capacity of the screen from 23.8 to approximately 30 moisture-free tons per day. However, the consistency control was not perfect and the relationship is rough with the exception of the final trial when a consistency of 1.00% was held and permitted a rate of flow of 28.8 tons per day with the rejects being reduced to less than 1%. If it had been deemed practical to operate at higher temperatures on a full mill scale, the discrepancies of capacity and percentage rejects would have been explored further. It should be noted however, that the effect of consistency on the percentage rejects is quite phenomenal and leads us to believe that consistency control is a prime factor in the successful operation of the Ahlfors unit.

Another operating variable investigated was the amplitude or travel of the screen plate. To accomplish this change, the weights attached to the eccentrics were varied from two to six. Table VA portrays the results obtained on pine pulp using two and four weights. The results indicate a slight increase in capacity and a possible improvement in the dirt and shive count on the accepted stock. A comparison of the cleanliness of the stock being passed by the Ahlfors with that existing with the flat screens on the same stock, shows a drop in both cases although the drop through the Ahlfors is of greater magnitude. The data are too sketchy to be positive on this point.

Not because the cleanliness of the accepted stock was inacceptable, but due to plate breakage, the 12-cut plate previously used was replaced with one having 10-cut slots. The effect of plate travel, or amplitude, was further investigated using the 10-cut plate. Table VB presents the data for pine pulp. Briefly, the production rates were increased substantially with the increase in plate travel although the effect of slot size overshadowed that produced by changing the weights on the eccentrics. The blinding consistency, or plugging, was much lower in the case of the smaller slot size, a result not completely unexpected. Again, it would appear that slight improvements in cleanliness follow the addition of more eccentric weights. The horsepower input per ton of accepted stock decreased as the tonnage increased. This relationship was expected.

Table VC duplicates Table VB excepting for the type of pulp processed. In Table VC, hardwood pulp was used and other than a drastic increase in the pro-

Table VIB. Comparison Between Ahlfors and Flat Screens Based Upon Average Tests (Hardwood)

Ahlfors, % moisture-free consistency	1.40	..
Ahlfors moisture-free tons/day	44.8	..
Total section of flat screens run[a]	26	23
Decker, % moisture-free consistency	0.76	0.73
Flat screen headbox, % moisture-free consistency	1.07	1.19
Flat screens, moisture-free tons/day/section[a]	17.7	21.5
Bleach plant rate, moisture-free tons/day	489	489
Bleach plant, Cl_2 No.	7.0	7.2
Bleach plant, B.S. viscosity	28.9	26.8
Bleach plant, B.S. % moisture-free consistency	3.98	4.37
Water removal by deckers, g.p.m.	8280	8830
Power requirements (av. hp./ton), Ahlfors	2.7	..
Power requirements (av. hp./ton), flat screens	2.9	..
Shives/gram, Ahlfors	25	..
Shives/gram, flat screens	36	..
Dirt count, Ahlfors	0.57	..
Dirt count, flat screens	0.46	..

Conditions: hardwood pulp; input shaft speed of Ahlfors 1300 r.p.m.; 4 weights on eccentrics of Ahlfors; 12-cut plates.
[a] Calculated on basis of first two sections of each tailing screen being effective.

Table VII. Screening of Rejects from Tailing Screens (Nos. 10 and 11)

	Moisture-free consistency, %	G.p.m.		Tons/day
Feed	0.52	325		10.2
	0.43	325		8.3
			Av.	9.2
Rejects	1.02	150		9.2
	1.25	85		6.5
			Av.	7.9
Accepted	0.095	175		1.0
	0.122	240		1.8
			Av.	1.4

Conditions: pine pulp; input shaft 1300 r.p.m.; 4 weights on eccentrics; 10-cut plates.

duction rates with this smaller diameter fiber, the relationship of plate travel and capacity, cleanliness, and horsepower requirements was the same as that for pine pulp. In other words, an increase in amplitude reflected more tons per day through the plate, slight increases in dirt removal, and lowering horsepower usage per ton of pulp produced.

It might be well at this point to review the method used for the cleanliness studies. The method is strictly empirical and is valueless except for comparative purposes. Representative samples of the accepted stock were procured throughout each trial run period. From the composite of the samples, handsheets containing 0.75 gram of stock were made. The shives in these sheets were classified as either being bleachable or unbleachable and the total count noted. The dirt specks were sized in terms of square millimeter per gram of pulp and totaled. In all cases a comparison was made with the production off of the flat screens so that changes in the over-all cleanliness levels could be discerned. The selectivity objective was to produce screened stock with the Ahlfors unit at least as clean as that from the flat screens.

As the major objective of this study was to evaluate the productive capacity of the Ahlfors screen in relation to the conventional flat screen installation, Table VIA compares the average flow rates of the two units under the optimum operating conditions heretofore established. It is concluded that an Ahlfors screen will produce the equivalent of two, 14-plate sections of flats. It is interesting to note that the productive capacities of these two methods of screening pulp are in direct relationship to the stock consistencies supplied to the units. The conventional flat screens accept pine stock slurries at consistencies varying from 0.5 to 0.6% and produce slightly in excess of 14 moisture-free tons of accepted stock per day. The Ahlfors screen on the other hand, will operate at consistencies of 0.9 to 1.0% and deliver 25 to 27 moisture-free tons per day. The ratio of consistency to production is substantially a straight line function.

The data available for hardwood pulps follow the same general pattern as that for pine pulps. The higher consistencies, 1.40%, fed to the Ahlfors screen permit the acceptance of approximately 45 moisture-free tons per day as compared to a tonnage rate of 18 to 22 moisture-free tons for the flat screens at 0.75% consistency. Again the ratio of consistency to production remains fairly constant. In the case of both runs, but particularly for pine, the deckering capacity was not sufficient to allow wide variations in the consistency of the stock to the flat screens. The premise is ma however, that for either unit, whether it be the screens or the upflow screens, that maximum cons ency is desirable for maximum production.

The investigation of the upflow principle of st screening was confined primarily to the use of the A fors unit as a primary screen. To evaluate its poten as a tailing screen, the tailings from the flat screen s tem were pumped to the weir box of the Ahlfors fo 4-hr. continuous period. The data collected during t run are shown in Table VII. A 10-cut screen pl was used and produced a separation of acceptable fi and rejects with very satisfactory results. Althou the experience was quite limited, it is suggested t the application of an Ahlfors unit as a tailing scr would be successful. It should be remembered that stock delivered to the Ahlfors screen had alrea been subjected to the action of the flat screen tail lines.

SUMMARY

The trial installation, as shown in Fig. 1, did not all an accurate control of consistency. For this reas full advantage of the value of high consistency co not be realized. The uncontrollable variations in c sistency changed the rate of rejection appreciably a made it difficult to maintain a constant flow of st through the unit. A permanent installation wo necessitate the control of consistency within qu narrow limits if the maximum benefits of high prod tion and low reject flow were to be effected.

The advantages of high density screening app to be as follows:

1. High production rates per unit of screening area.
2. Satisfactory separation of the acceptable fiber and rejectable dirt and shives.
3. Lower initial capital cost for brown stock screening a higher production rates.
4. Decreased deckering capacity due to the higher con encies.
5. Possible operating man-hour savings based on a more co pact installation and less equipment.
6. Possible reduction in maintenance cost for screening w the decrease in screening area per ton of pulp.

In addition to the advantages of high density scre ing the design of the Ahlfors unit lends itself to nea full automatic control. The backwash system w found to be completely satisfactory and the different head principal of feed guarantees flooded plates at times. The upflow arrangement encourages the sep ration of good fibers and dirt by allowing the force gravity to move the more dense particles downwa while the screen plates pass the acceptable stock u ward. The slight improvement in cleanliness, as co pared to the conventional flat screens, may be credit to the upflow principle in that the dirt is not allowed accumulate on top of the screen plates. It is reasona to suppose that dirt in contact with the vibrating pl becomes more finely divided and thus is resized to extent where some of it passes the slots with the ceptable fiber.

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Acknowledgment is due to the Oliver-United Filter Co. for the loan of Ahlfors screen during the period of this study. Thanks are also extende Messrs. Kenney, Calhoun, Schorken, Girdwood, and Decew for their u mitting assistance.

Sulphonation of Wood Lignin

G. A. RICHTER and L. H. PANCOAST, JR.

The work reported covers sulphonation and delignification of several wood species with sulphurous acid solutions of increasing concentrations and over a wide spread of temperatures. Low temperature sulphonations were made over periods of time extending to 16 months. In many instances the low temperature sulphonations were followed by short high temperature digestions. Degree of sulphonation of the wood lignin was determined and removal of solubilized lignin measured. It is shown that: (1) With 10% SO_2 solution there is progressive extraction of lignin over long periods of treatment at room temperature but at no time up to a 16-month soak did the chemically combined sulphur in the wood substance exceed 8% based on lignin. (2) Rate and degree of sulphonation is dependent on SO_2 concentration and temperature. At a given SO_2 concentration rate of sulphonation is depressed as increasing percentages of combined SO_2 are added to the solution. (3) Combined sulphur in the extracted lignosulphonate reaches levels of 8 to 10% when sulphonations are carried out at room temperature. (4) Prehydrolysis interferes both with low temperature sulphonation and with subsequent pulping in SO_2 solution at elevated temperature. (5) High temperature hydrolysis of presulphonated wood with solutions containing no SO_2 resulted in only partial delignification except where presulphonation had been done with SO_2 solution to a level of over 4% sulphur based on lignin. Similar delignification of wood that had been sulphonated with bisulphite or sulphite at high temperature proved much more difficult. (6) Sulphonation of birch lignin with low temperature SO_2 solution is much slower than found with hemlock, spruce, and Douglas-fir. (7) A very rapid and almost complete extraction of lignin from hemlock is possible by a process comprising a 2-week sulphonation with 10% SO_2 solution at room temperature followed by a 2 to 4-hr. digestion in the same liquor at 120°C.

Sulphonation of wood lignin with sulphurous acid has been studied by many investigators. Results of such work show that it is possible to render lignin water soluble if sulphonation is brought to a 3.5 to 4.0% sulphur level and the sulphonated lignin then hydrolyzed. Such second stage delignification is more easily accomplished if some hydrolysis accompanies the sulphonation stage as is easily demonstrated when comparing the behavior of lignosulphonates made with free sulphurous acid with that of those made with neutral or slightly alkaline sulphites.

It is generally accepted that although some of the native lignin present in the wood is rendered water soluble by light sulphonation and with mild hydrolysis, the larger portion requires a higher degree of sulphonation and ultimately a more severe hydrolysis of its sulphonic acid derivative to bring about water solubility.

The work here reported aims to extend the findings of other investigators and deals more particularly with sulphonations made at low temperature and with solutions that contain no bisulphite nor other buffer material.

Except where otherwise noted, the experiments were carried out with western hemlock wood in the form of matchlike units having a thickness approximately that of mill made chips. Treatments were made in large flasks that were sealed after loading. The sulphurous acid was applied in a 10 to 1 liquor-wood ratio, thereby assuring complete submergence of wood. Reaction was continued for the periods of time chosen and at the temperature in question.

The wood products resulting from such treatments were washed many times by overnight soaks in distilled water and the washed products were submitted for lignin and sulphur analyses. Portions of spent liquor were recovered and evaporated under high vacuum at 50°C.

Rate of sulphonation was determined, and the extraction of sulphonated lignin calculated. In some instances the sulphur content in the recovered solids of the spent liquor was determined, and calculations were made to determine sulphur based on solubilized lignin with suitable correction for nonlignin components that had been extracted from the wood during the treatment.

The preliminary study was confined mostly to low temperature sulphonation. Later this was supplemented by a series of experiments in which the presulphonation was followed by hydrolysis or by further sulphonation and hydrolysis of the sulphonated lignin at higher temperature and under a variety of conditions. Such secondary digestions were made by heating the sealed flasks in closed digesters partially charged with a like solution so that inside and outside pressures would be equalized to prevent glass breakage.

LONG SULPHONATION PERIODS AT ROOM TEMPERATURE

In a first set of experiments, matchlike western hemlock chips were soaked in 10% SO_2 solution at room temperature (25 to 30°C.) for increasing time periods. Figure 1 shows the progress of sulphonation as the reaction was continued for 16 months. Shown also are the yields and the lignin contents of recovered washed products.

The data are rearranged in Fig. 2 in which sulphur based on lignin is plotted against lignin remaining in wood and also against per cent of original lignin removed.

Lignin analyses show a slight increase during the early stages of treatment. This is explained by a more rapid extraction of some of the nonlignin constituents originally present in the wood. This solubilized nonlignin component must comprise an easily hydrolyzed carbohydrate since a thorough washing of the original wood with distilled water alone results in a 99% yield; furthermore total extractables as determined with organic solvents amount to less than 3%.

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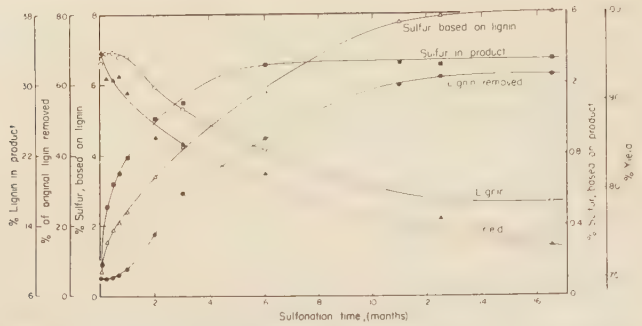

Fig. 1. Room temperature sulphonation of hemlock lignin in 10% SO_2 solution

From yields and analyses of the respective products obtained from soaks in a 10% SO_2 solution for a 1 to 2-week period, one can show an extraction of about 9% of the nonlignin components of the original wood. This value is increased to only about 10 or 12% through the 16-month period, thus indicating a limited percentage of native cellulose and pentosans solubilized under these mild conditions of treatment.

Only a small part of the lignin is solubilized during the first few weeks of treatment. As the period is extended to 6 months about 45% of the original lignin is extracted and this is further increased to 62% as the treatment is continued to 16 months.

Combined sulphur based on residual lignin in the wood substance increases fairly rapidly in the early stages, and at the end of 11 months reaches 8% which corresponds to the ratio of 1 sulphur to 20 carbons reported as reached by other investigators using other conditions of sulphonation. No further increase was noted through the 16-month period.

In the case of soaks that were made for 3 months or longer the solids were recovered from the spent liquors by evaporation under high vacuum. When corrected for calculated carbohydrate and sulphonic acid groups present, the sulphur content of the liquor solids amounts to 8 to 10% of the lignin contained therein (see Table I). This figure is slightly higher than the sulphur based on remaining lignin in the treated wood product and appreciably higher than the 3.5 to 4% figures that have been reported by others as needed to render the lignin water soluble. The high temperature water extraction of the sulphonated lignin used by those experimenters

Table I. Sulphur Content of Extracted Lignin

Gram balance based on 100 grams wood

Sample	*3 mo.*	*6 mo.*	*11 mo.*	*12½ mo.*	*16½ mo.*
Ratio of lost lignin to total loss from wood	0.569	0.675	0.740	0.744	0.720
Solids in spent liquor	13.5	21.25	26.8	33.0	31.3
Sulphur in spent liquor solids	0.62	1.2	1.43	1.88	1.89
Equivalent sulphonic group (HSO_3) in spent liquor solids	1.57	3.04	3.62	4.76	4.79
Sulphur free solids in spent liquor	11.9	18.21	23.2	28.2	26.5
Lignin in spent liquor (calc.)	6.78	12.28	17.17	21.0	19.1
Sulphur based on lignin in spent liquor, %	9.15	9.79	8.35	8.96	9.90

Table II. Sulphonation of 1-In. Cubes

In all cases: 1-in. hemlock cubes; room temperature; 10% SO_2 solution; 3 weeks' soak time

Set no.	*Moisture content of wood, %*	*Yield, %*	*Lignin, %*	*Zone*[a]	*Sulphur, %*	*Sulph based lignin,*
1	Oven-dry	89.0	32.7	Outer	0.68	2.1
				Second	0.73	2.2
				Central	0.73	2.2
2	67.4	89.6	32.5	Outer	0.72	2.2
				Second	0.77	2.4
				Central	0.76	2.3

[a] In cutting zones from the cubes the outer 1/8-in. layer cut with the s was the outer zone, the next 1/8-in. layer was the second zone, the remai 1/2-in. square portion was the central zone.

very probably accounts for the greater solubility at lower sulphonation level.

The lower maximum sulphur figure of 4% repor by Brauns is probably explained by the weaker (5 SO_2 solution which he used in reaching his maxim sulphur based on lignin at the 110-day point. Ot experiments done by the authors have failed to re over about 5% in the unextracted lignin when digest temperatures of 100°C. or higher have been used w sulphurous acids or with bisulphites. It is likely t the 8% level obtained with the 10% SO_2 at the lo sulphonation temperature is explained in part b more rapid sulphonation than hydrolysis under th reaction conditions.

From the above one can postulate that:

1. Certain small portions of the native lignin easily solubilized in the early stages of sulphonati thus indicating a fairly low degree of polymerizat and little need of acid hydrolysis.
2. There are probably high molecular fraction the lignin in the wood that require more sulphona before hydrolysis can render them soluble.
3. Portions of this high molecular lignin req more drastic hydrolysis of the sulphonate to be water soluble. Thus under the conditions of experiments in question this lignin reaches a hig degree of sulphonation before the hydrolysis has p ceeded to the necessary extent.
4. Some condensation may occur during the lon exposure times and such modified lignin may require even higher degree of sulphonation or a longer perio hydrolysis before it can be extracted.
5. If, as is proposed by some investigators, some the lignin is originally bound to the native cellulose pentosan, one can decide that such bonds are broken

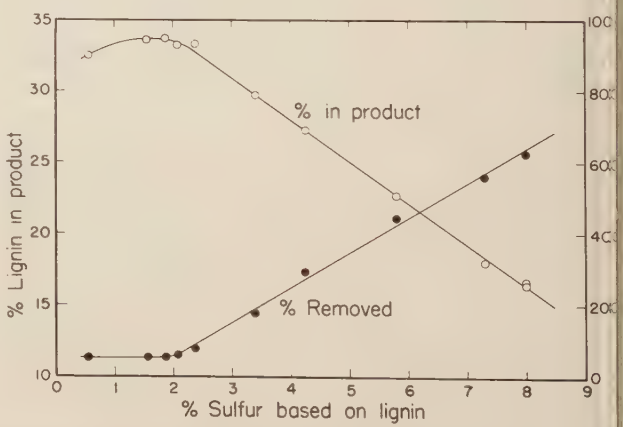

Fig. 2. Influence of degree of sulphonation on lig removal from hemlock wood

hydrolysis and that the sulphonated lignin is thus rendered water soluble. One can postulate further that a reverse sequence of hydrolysis followed by sulphonation is not successful in bringing about appreciable solubility because of greater ease of condensation of the unsulphonated lignin groups as liberation from the carbohydrate occurs.

6. There is also the possibility that the extracted lignin is further sulphonated during the long contact with free SO_2.

SULPHONATION OF LIGNIN IN LARGE WOOD UNITS

Sulphonation occurs with surprising ease even in the innermost region of relatively large wood blocks. This is shown in Table II. One-inch cubes of hemlock were soaked in 10% SO_2 solution at 30°C. for 3 weeks. The cubes were then zoned by slicing successive 1/8-in. sections with the grain. An innermost core of 1/2-in. thickness comprised the third sub sample. After thorough washing, all three portions show practically the same combined sulphur, indicating that travel of sulphur dioxide grainwise through the cubes had taken place easily with sufficient reagent present in all parts to assure uniform sulphonation.

INFLUENCE OF SO_2 CONCENTRATION

Results obtained with increasing concentrations of sulphur dioxide solutions and with 2-week soaks are shown in Fig. 3 and demonstrate clearly the higher levels of combined sulphur obtained when stronger solutions are used. Trials at longer time periods are under way to determine whether the ultimate sulphonation possible at the lower concentrations is also less than obtained with the strong solutions. This concentration influence is also seen in Fig. 4, in which rate of sulphonation is plotted for the several sulphur dioxide concentrations. Here again both concentration and time are major factors. In the plotted data, there is evidence that total yields are higher as sulphur dioxide concentration is decreased but the lignin percentage in the treated products were all close to the percentage present in the base wood (33%).

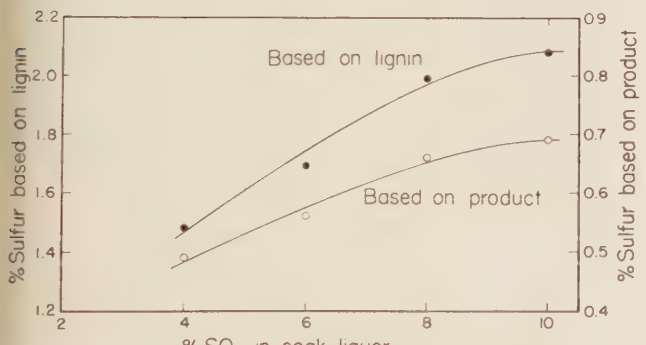

Fig. 3. Influence of concentration of SO_2 solution on sulphonation

Soaked 2 weeks at room temperature.

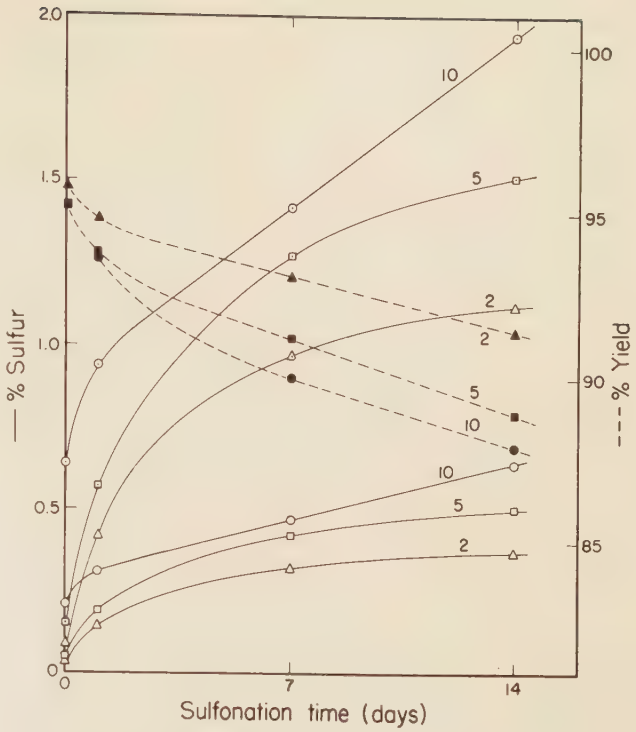

Fig. 4. Sulphonation of hemlock shavings at room temperature with 10, 5, and 2% SO_2 solutions

Upper three sulphur curves are based on lignin.
Lower three sulphur curves are based on product.

Figure 5 shows corresponding results obtained with a spruce groundwood. Both the sulphonation rates and the yield figures are much as found with the hemlock wood. These groundwood figures support the belief that with time periods of 24 hr. or more the penetration factor in the case of the matchlike chips is of no measurable importance.

INFLUENCE OF SULPHONATION TEMPERATURE

Rate of sulphonation of lignin is greatly increased as the temperature of treatment is raised. Data plotted in Fig. 6 show this influence at four concentrations of chemical. In this instance, mill-type wood chips were used instead of "matches" and treatments were carried out for 12 hr. with no relief of gas during the cook period. The increased sulphonation obtained with the higher

Table III. Influence of Temperature on Sulphonation

In all cases hemlock wood

Temperature, °C.	*Time*	*% SO_2*	*Wood form*	*Yield, %*	*Sulphur, %*	*Lignin, %*	*Sulphur based on lignin, %*
50	1 hr.	5	Shavings	95.8	0.16	31.5	0.51
50	24 hr.	5	Shavings	89.8	0.48	32.8	1.46
50	1 hr.	2	Shavings	96.4	0.11	32.2	0.34
50	24 hr.	2	Shavings	91.8	0.37	31.9	1.16
Room	1 hr.	5	Shavings	95.2	0.05	32.5	0.15
Room	24 hr.	5	Shavings	93.8	0.19	33.0	0.58
Room	1 hr.	2	Shavings	95.8	0.03	32.1	0.09
Room	24 hr.	2	Shavings	94.8	0.14	32.8	0.43
0	2 wk.	10	Matches	92.3	0.22	32.1	0.69
Room	2 wk.	10	Matches	92.5	0.63	33.5	1.91

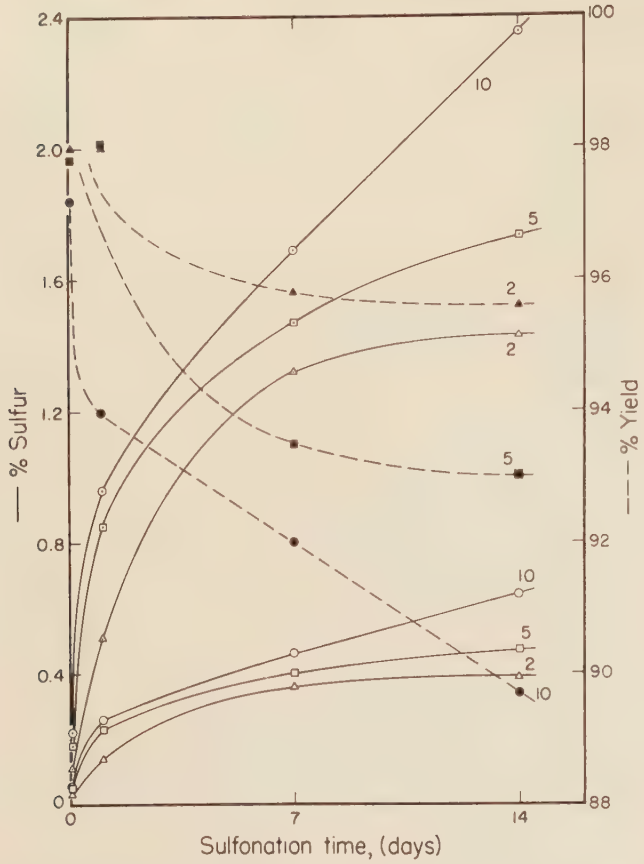

Fig. 5. Sulphonation of spruce groundwood at room temperature with 10, 5, and 2% SO_2 solutions

Upper three sulphur curves are based on lignin.
Lower three sulphur curves are based on product.

sulphur dioxide concentrations is strongly evident. When these results are compared with corresponding sulphonations done at room temperature, it is seen that the same degree of sulphonation of the unextracted lignin is reached in 12 hr. at 50°C. as is reached in 5 to 6 days at the lower temperature. At 75°C. the reaction proceeds to a point that requires about 2 months at 30°C. Removal of lignin from the wood is less than 10% at 50°C., but at the higher temperature somewhat more than 20% of the original lignin was rendered water soluble.

Another series of results is shown in Figs. 7 and 8. In this case digestions were made at 100°C. and at 120°C. for 5-hr. period and with sulphur dioxide concentrations ranging from 1 to 15%. Again a rapid sulphonation is evident and to increasing levels as concentration is raised. The slightly lower sulphonation found with the higher concentrations at 120 than at 100°C. is explained by the greater extraction of sulphonated product as reflected in the lower over-all yield and the lower lignin content of the end product.

The values show again that with the lower concentration of sulphur dioxide the sulphonation is appreciably less even at the higher temperatures. Here also more work is needed to demonstrate whether prolonged heating at the lower concentratons will ultimately result in a substantially higher level of sulphonation. Such experiments become somewhat complex in view of the accompanying hydrolysis that takes place at increasing rate when high temperatures are used as well as because of partial deactivation of lignin as time of treatm continues.

This influence of temperature is further dem strated in Table III which reports results obtained w hemlock shavings at two time periods and at the lo sulphur dioxide concentrations. Results conf closely to those already discussed. In a single exp ment carried out with matches in 10% solution at 0 for 2 weeks, combined sulphur reached only 0.22% contrasted to 0.63% when a corresponding treatm was made at room temperature. These figures, o further evidence that under conditions of the exp ments in question influence of temperature on rate sulphonation is decidedly greater than is penetration reagent into the wood structure.

INFLUENCE OF SECOND COMPONENT IN SOA LIQUOR

Other components in the sulphurous acid solution affect the ease of sulphonation if present in sufficie quantity. Typical results shown in Table IV w obtained with solutions that contained 10% free together with the second component when used. several sets cited were made at different time peri and hence show a somewhat different base line for co parison depending on the room conditions at the ti the particular group was treated.

In no instance was sulphonation rate increased by presence of the second reagent. Combined sulp dioxide in low concentration showed no influence dur a 3-week soak. When raised to 1%, sulphonation creased moderately. The presence of other mine acids in concentrations reported show little, if any, fluence. Glycerine is ineffective but isopropyl alco in fairly high concentration had a depressing influe

As expected, much less sulphonation occurs when sulphur dioxide is in an olive oil or acetic acid med Whether small percentages of water in the acetic a would make a difference was not determined.

The influence of combined sulphur dioxide on s phonation is further demonstrated in Table V. data show a progressive decrease in sulphonation as bisulphite is increased whereas the presence of sodi sulphate in amounts needed for easy pulping shows

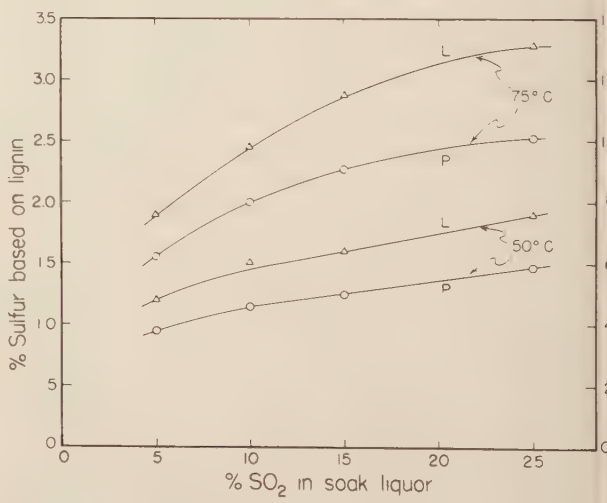

Fig. 6. Influence of SO_2 concentration on sulphonat of hemlock chips at two temperatures

Soak time = 12 hr. L = per cent sulphur based on lig P = per cent sulphur based on product.

Table IV. Second Component in Liquor

In all cases: hemlock matches; room temperature; 10% free SO_2

Second component	Time, weeks	Yield, %	Sulphur, %	Lignin, %	Sulphur based on lignin, %
Set I					
None	2	90.3	0.74	33.4	2.21
1% H_2SO_4	2	89.5	0.74	32.0	2.31
1% HCl	2	91.1	0.73	33.1	2.2
Set II					
None	3	92.3	0.67		
1% H_2SO_4	3	93.0	0.67		
1% comb. SO_2 (Na)	3	93.5	0.56		
10% glycerine	3	90.2	0.65		
50% isopropyl alc.	3	91.6	0.45		
Set III					
None	3	93.1	0.63	32.4	1.95
1% H_2SO_4	3	92.3	0.63	33.4	1.89
5% H_2SO_4	3	93.3	0.64	31.7	2.02
1% HCl	3	92.5	0.68	32.0	2.12
0.2% comb. SO_2 (Na)	3	94.3	0.66	31.6	2.09
0.2% comb. SO_2 $N(HN_3)$	3	93.0	0.63	31.6	1.99
SO_2 in olive oil	3	93.5	0.23	..	..
SO_2 in acetic acid	3	98.0	0.21	..	..

such depressing effect. The lower rate of sulphonation when the combined sulphur dioxide is added to the sulphurous acid solution can be explained, partly at least, by the corresponding reduction in the totally free sulphur dioxide as reflected in pH values of the respective liquors. It is interesting to note that the strong bisulphite solution shows less sulphonation than the 10 and 20% sodium sulphite liquors suggesting that there may be an intermediate pH level at which sulphonation rate would be at a minimum.

DEACTIVATION OF LIGNIN BEFORE SULPHONATION

The well-known deactivation of wood lignin as brought about by treatment with strong acids or with dilute aqueous solutions at elevated temperatures is reflected in the diminished sulphonation that occurs when wood is so pretreated before low temperature sulphonation is practiced. This is illustrated in Table VI. Exposure to strong mineral acid at room temperature for a 2-week period causes profound loss of activity.

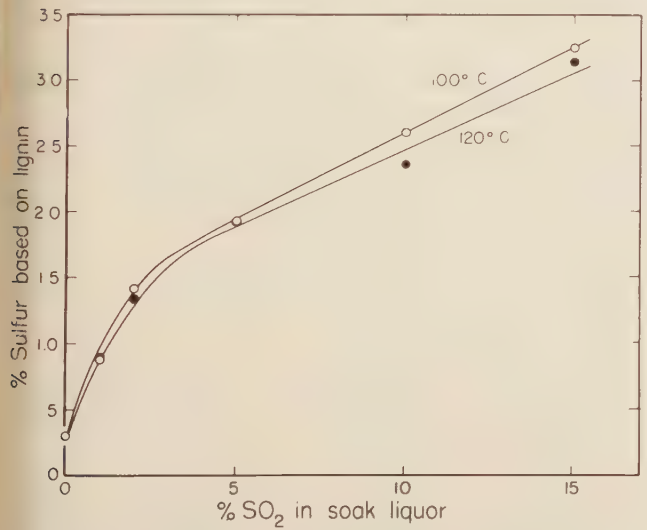

Fig. 7. Influence of SO_2 concentration on sulphonation of hemlock chips at higher temperatures

Soak time = 5 hr.

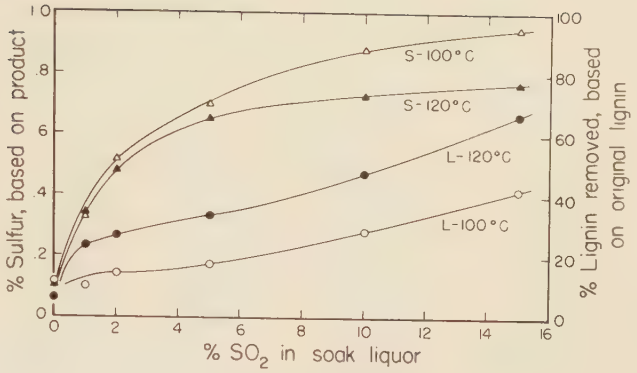

Fig. 8. Sulphonation and delignification at higher temperatures

Wood = hemlock chips. Soak time = 5 hr. S = per cent sulphur based on product. L = per cent of original lignin removed.

When such prehydrolyzed wood is then sulphonated, over-all yield is low with a corresponding high lignin in product indicating a high extraction of carbohydrate material and inappreciable removal of lignin.

High temperature digestions in water, or in 1% SO_2 solution also showed the expected effect on lignin deactivation. These deactivations parallel the poor pulping obtained when similarly pretreated wood is then processed at elevated temperature with the orthodox acid cooking liquors.

The pretreatment with strong chlorine water is interesting in that the lower degree of sulphonation is accompanied by a lower lignin in the end product. One explanation may be a reduction in molar weight caused by chlorine water which in turn could favor a solution of lignin at a lower sulphur level.

HYDROLYSIS AFTER SULPHONATION

Lignin that has been sulphonated at room temperature can be extracted in part by hot water or weak acid hydrolysis. In a first set of experiments (see Table VII), sulphonation was carried out in 10% SO_2 solution for a 2-week period at which time the lignin had taken on about 2.4% sulphur. Subsequent digestions in the liquors chosen resulted in only a partial removal of the lignosulphonate as measured both by reduction in sulphur and loss of lignin. The relatively high lignin percentage found in the resulting products is explained by a substantial extraction of carbohydrate under these hydrolyzing conditions.

Failure to remove sulphur more completely in the digestion stage supports the viewpoint that some of the

Table V. Influence of Combined SO_2 in the Sulphonation Liquor

Hemlock matches; sulphonation at room temperature for 3 weeks; sodium base combined SO_2; washing procedure included a 5% HCl, 20 °C. soak to remove ash

Free SO_2, %	Combined SO_2, %	pH of liquor	Yield, %	Sulphur, %	Lignin, %	Sulphur based on lignin, %
10	..	0.90	90.0	0.65	34.0	1.91
10	1	1.16	90.8	0.56	33.7	1.66
10	2	1.29	91.0	0.53	33.1	1.60
10	4	1.48	92.5	0.46	34.4	1.34
10	3% Na_2SO_4	0.91	90.6	0.61	33.8	1.80
5	5	4.08	94.5	0.21	34.4	0.61
0	5[a]	9.56	93.5	0.29	33.9	0.86
0	10[a]	9.89	93.5	0.30	33.8	0.89

[a] Actually 10 and 20% Na_2SO_3 solution.

Table VI. Influence of Pretreatment on Sulphonation

Hemlock matches; pretreatment followed by sulphonation at room temperature with 10% SO_2 solution

Pretreatment				Soak in 10% SO_2				
Reagent	*Temp., °C.*	*Time,*	*Yield, %*	*Time, weeks*	*Yield, %*	*Sulphur, %*	*Lignin, %*	*Sulphur bas on lignin, %*
Water	30	3 wk.	...	3	88.4	0.78	34.4	2.26
5% HCl	30	2 wk.	92.5	3	83.6	0.58	34.5	1.68
25% HCl	30	2 wk.	...	3	70.5	0.17	41.0	0.41
Water	150	2+3 hr.	81.6	3	78.7	0.58	35.7	1.63
Water	160	2+3 hr.	77.1	3	74.8	0.48	38.9	1.23
Water	170	2+3 hr.	74.5	3	72.4	0.41	40.3	1.02
1% SO_2	100	2+3 hr.	81.6	3	79.1	0.69	37.7	1.83
1% SO_2	110	2+3 hr.	77.4	3	76.4	0.61	37.3	1.63
1% SO_2	120	2+3 hr.	72.4	3	71.4	0.54	37.5	1.44
Saturated chlorine	20	4 hr.	...	3	85.7	0.52	27.6	1.88

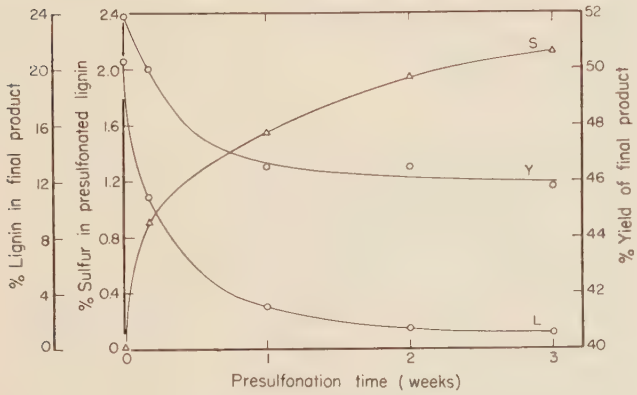

Fig. 9 Influence of time of presulphonation on subsequent pulping

10% SO_2 solution used throughout. Pulping conditions 120°C., 8 hr. S = per cent sulphur in presulphonated lignin. Y = per cent over-all yield. L = per cent lignin in product.

lignin had not reached a sulphonation level required; nor had it undergone sufficient preliminary hydrolysis for subsequent solubilization. Figures of sulphur based on lignin calculated for the extracted solids are relatively high, ranging from 7 to 13%, and suggest that such extracted lignosulphonate is rich in sulphur or that some desulphonation had occurred leaving a residue of regenerated lignin in the extracted wood, thus causing the calculated per cent sulphur to lignin in the extract to be higher than actually corresponds to the water-soluble lignosulphonate itself.

A second set of experiments was made to extend the study of lignosulphonate removal by water hydrolysis. This time three types of sulphonating reagents were employed, the usual 10% SO_2 solution, a 20% sodium sulphite solution, and one made up to contain 1 free and 10% combined SO_2. Sulphonations w continued for a 3-month period at room temperatu after which the products were thoroughly wash with a sequence that included a cold acid step desig to convert the sodium sulphonate to the free a These products were then post-treated with distil water at 130°C. for 6 hr. Table VIII shows the p tinent data. As in earlier cases cited, the sulphite a the bisulphite cause appreciably less sulphonation t obtained with the sulphurous acid. This difference

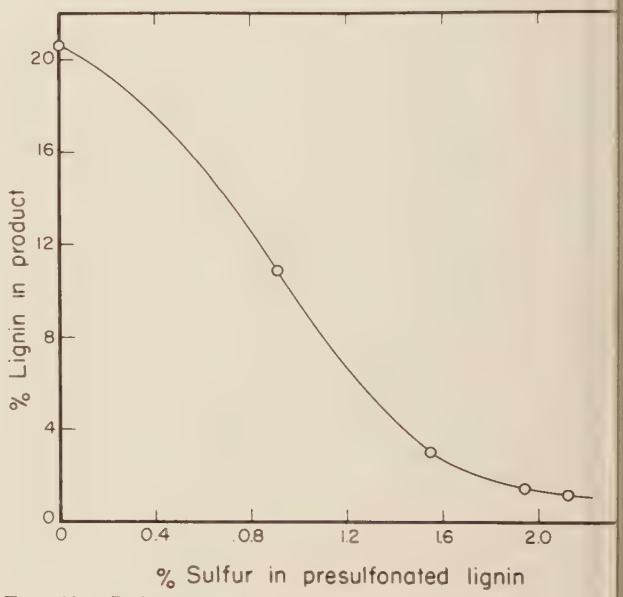

Fig. 10. Influence of degree of sulphonation on sub quent delignification; conditions as in Fig. 9

Table VII. Post-treatments of Sulphonated Wood

Hemlock matches used; initial soak made with 10% SO_2 solution; room temperature; two-week period

Stage I (Soak)					
Yield, %	90.5	91	91	91	91
Sulphur, %	0.79	0.79	0.79	0.79	0.7
Lignin, %	33	33	33	33	33
Original lignin removed, %	9	9	9	9	9
Stage II					
Reagent	Water	10% AcOH	1% H_2SO_4	2% H_3PO_4	W
Temperature, °C.	150	120	120	120	120
Time, hr.	3	8	8	8	8
Over-all yield, %	60.6	69.4	67.3	68.5	69.
Sulphur, %	0.37	0.31	0.37	0.34	0.3
Sulphur based on lignin, %	0.86	0.94	0.94	0.91	0.9
Lignin in product, %	43	33.1	39.3	37.2	34.
Original lignin removed, %	21.2	30.3	20.0	23.0	27.
Sulphur removed, %	69.0	70.0	65.5	67.9	70.
Sulphur associated with extracted lignin in stage II, %	12.9	7.2	13.1	10.6	8.4

Table VIII. Post-treatments of Wood Sulphonated by Various Methods

Hemlock matches used; room temperature soaks intermediate wash included 5% HCl, 20°C. soak; post-treatment in distilled water at 130°C. for 6 hr.

Stage I (soak)			
Reagent	10% SO_2	20% Na_2SO_3	10:10 acid
Time, mo.	3	3	3
Yield, %	85.0	92.0	93.8
Sulphur, %	1.22	0.36	0.26
Lignin, %	26.7	34.1	33.9
Sulphur, % based on lignin	4.56	1.05	0.77
Original lignin removed, %	31.1	4.9	3.6
Stage II			
Over-all yield, %	45.5	67.6	68.1
Sulphur, %	Estimated trace	0.23	0.22
Lignin, %	3.22	36.9	38.5
Sulphur, % based on lignin	..	0.62	0.57
Original lignin removed, %	95.5	24.6	20.6
Sulphur removed, %	All	53.1	38.5
Sulphur associated with extracted lignin in stage II, %	4.87	2.71	1.68

sulphonation level carries through to the hydrolysis stages which show substantially complete delignification with the more highly sulphonated intermediate and no pulp with the other two. The almost complete delignification of the sulphur dioxide sulphonated wood in the water hydrolysis stage explains the 4+% sulphur based on lignin calculated for the extracted material. If the desulphonation viewpoint cited above in connection with hydrolysis that follows a short sulphur dioxide sulphonation is accepted, one can then postulate that with the much longer acid presulphonation, enough hydrolysis has occurred to allow an easy solubilization of the chemically unchanged lignosulphonate in the hot water digestion.

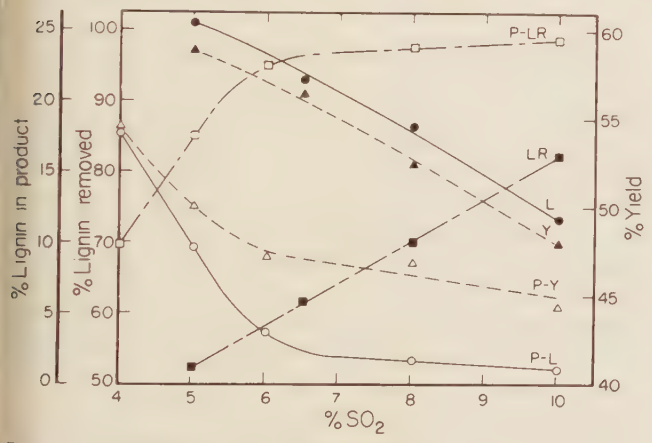

Fig. 11. Influence of presulphonation on subsequent pulping at various SO_2 concentrations

Presulphonation, where practiced, at room temperature for 3 weeks. Pulping in all cases at 120°C., 8 hr. Prefix *P* indicates pulping was preceded by presulphonation. LR = per cent lignin removed. L = per cent lignin in product. Y = per cent over-all yield.

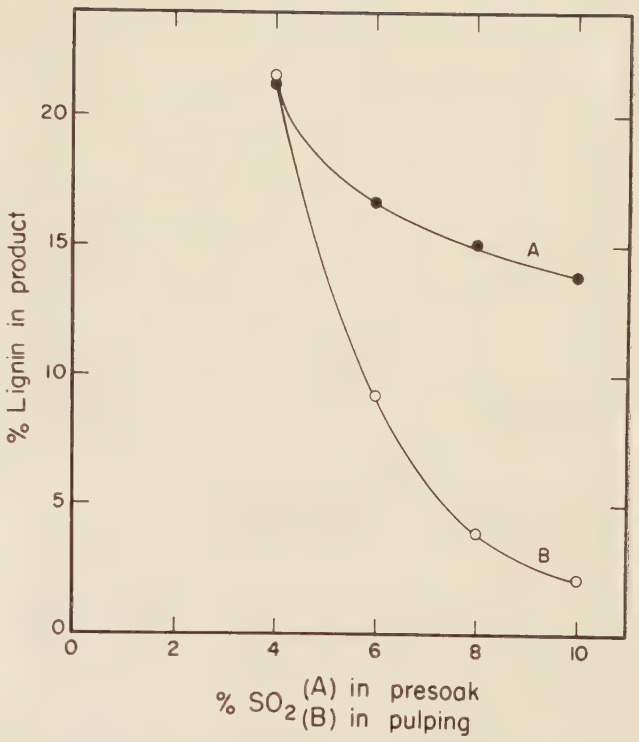

Fig. 12. Effect of independently increasing SO_2 concentration in the presulphonation and the pulping liquors

Set A—variable SO_2 concentration during presulphonation. Pulping done in 4% SO_2 solutions at 120°C., 8 hr. Set B—4% SO_2 during presulphonation. Pulping done in various SO_2 concentrations at 120°C., 8 hr.

Failure of the sulphite and the bisulphite soaked woods to pulp probably can be explained not only by the lower degree of sulphonation reached in the soak, but also by the limited depolymerization of lignin that occurs in the less acid solutions over the 3-month period. The low sulphur to lignin ratio calculated in the hot water extract is partly explained by removal of some of the unsulphonated lignin since it is readily shown that if the original wood is so digested without presulphonation, it loses nearly 10% of the original lignin.

SULPHONATION OF LIGNIN IN SEVERAL WOOD SPECIES

As expected and as shown in Table XI, wood lignins differ in the manner in which they sulphonate depending

Table IX. Sulphonation of 10% SO_2 Lignin in Several Wood Species

Wood species	*Chip form*	*Original lignin, %*	*Time,*	*Yield, %*	*Sulphur, %*	*Lignin, %*	*Sulphur based on lignin, %*
Douglas-fir	Matches	...	2 wk.	87.6	0.62	...	...
Douglas-fir (ext.)	Matches	...	2 wk.	87.4	0.58	...	...
Douglas-fir	Matches	...	3 wk.	89.5	0.58	34.7	1.67
White birch	Matches	22.3	2 wk.	93.2	0.20	19.8	1.01
White birch	Matches	22.3	3 wk.	90.4	0.22	19.2	1.15
White birch	Shavings	21.9	3 wk.	92.5	0.24	19.8	1.21
White birch	Shavings	21.9	3 mo.	91.0	0.41	19.1	2.15
Western hemlock	Shavings	32.6	3 wk.	88.8	0.76	33.0	2.30
Western hemlock	Shavings	32.6	3 mo.	83.0	1.26	29.3	4.30
Eastern spruce	Shavings	28.7	3 wk.	93.5	0.62	30.5	2.03
Eastern spruce	Shavings	28.7	3 mo.	85.9	1.06	25.3	4.20

(ext.) = solvent extracted wood.

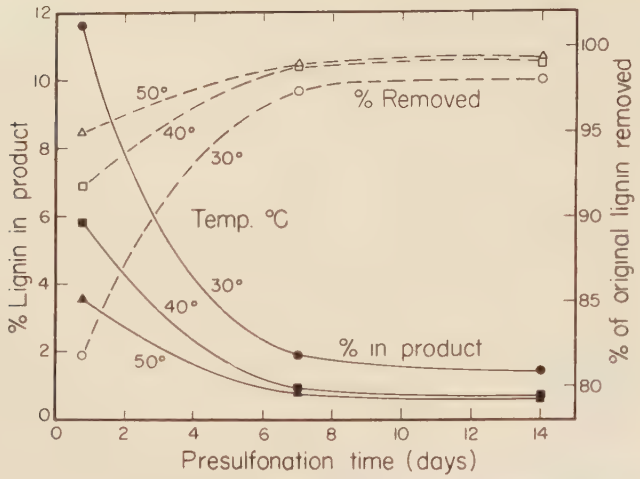

Fig. 13. Influence of presulphonation temperature (with 10% SO_2) on subsequent pulping

upon the wood species involved. The lower sulphur figures obtained with the birch lignin are particularly interesting in view of the practical experience that the hardwoods pulp more easily than do the spruce and hemlock. This suggests that hardwood lignin requires less sulphonation to reach the soluble stage or that the lignin has a lower degree of polymerization, or that the sulphonate is more easily hydrolyzed to a soluble form than found with the coniferous lignins. On the other hand, although many investigators have pointed out that Douglas-fir resists sulphite pulping except when first presulphonated with sulphite solution under high temperature conditions, the low temperature sulphonation results in sulphur levels comparable to those obtained with spruce and hemlock. Long-time room temperature sulphonations of Douglas-fir should yield additional data that would help explain the difficulty of pulping such wood in acid sulphite liquors.

The lower degree of sulphonation obtained with birch lignin is paralleled in a set of high temperature digestions made with 20% sodium sulphite solution as shown in Table X. Mill-type chips were used and the digested products well washed and deashed with weak cold acid. Here also the birchwood products show lower sulphur content as well as lower sulphur based on lignin than do the other wood species when similarly processed. Again the spruce and Douglas-fir are considerably closer to the hemlock in their behavior.

Further work is indicated with the various hard-

Table X. Sodium Sulphite Sulphonation with Several Wood Species

20% Na_2SO_3 used throughout

Wood species	*Temp., °C.*	*Time, hr.*	*Yield, %*	*Lignin, %*	*Sulphur, %*	*Sulphur based on lignin, %*
Hemlock	150	4	82	29.7	1.14	3.84
Hemlock	150	8	79	27.5	1.08	3.94
Hemlock	150	12	80	25.1	1.12	4.5
White birch	150	4	85	15.2	0.41	2.69
White birch	150	8	86	14.9	0.46	3.08
White birch	150	12	81	14.2	0.46	3.2
Spruce	130	6	87	29.6	0.99	3.4
Douglas-fir	130	6	86	26.4	1.13	4.3
White birch	130	6	87	18.5	0.40	2.1
Hemlock	130	6	87	28.0	0.87	3.1
Original wood lignin	*Spruce* 29.6	*Douglas-fir* 33.5		*White birch* 23.8		*Hemlock* 33

Table XI. Influence of Chip Size on Sulphona... Followed by Pulping

In all cases: hemlock wood; soak for 2 weeks at room t... perature; soak liquor was 10% SO_2; no intermediate wash... cook—120°C.—2 + 8 hr.

Size of wood units, in.	*Yield, %*	*Lignin, %*	*K num...*
$1/8 \times 1/8 \times 3/4$	41.8	1.08	4.(
$1/4 \times 1/4 \times 3/4$	40.2	1.14	4.3
$3/8 \times 3/8 \times 3/4$	42.8	1.19	4.8
$1/2 \times 1/2 \times 3/4$	41.1	2.79	5..
$1 \times 1 \times 3/4$	43.4	4.23	17.3
$1 \times 1 \times 1$	43.8	6.09	18.2
$1 \times 1 \times 3/4$ (no presoak)	53.8	26.26	..

woods and with the pines of Florida. Parallel w... with the hardwoods in liquors that contain both ... and combined sulphur dioxide as well as with sodi... sulphite solutions is also deserving of more attentio...

INFLUENCE OF DEGREE OF SULPHONATION ... SUBSEQUENT PULPING

The important influence of presulphonation on e... of subsequent pulping is readily shown when the ... sulphonated wood is then digested in the sulphu... acid by a procedure that prescribes a rapid rise t... chosen maximum temperature and a continuatio... the cook for a determined time period.

In a first series as shown in Fig. 9, the hemlock w... was first soaked in 10% SO_2 solution at room temp... ture for increasing time periods. Then, withou... change in acid liquor, the temperature of wood ... liquor was raised to 120°C. in 1 hr. and held there 8... Combined sulphur based on lignin in presoaked woo... well as lignin and yield of final products are plot... against time of presoak.

Figure 10 shows the combined sulphur after pr... phonation plotted against lignin in final prod... It is seen that under these conditions of presoak ... digestion, a sulphur level of about 1.5 to 1.8% base... lignin in the intermediate product is needed to b... about good pulping in the second stage.

Since combined sulphur is not appreciably distur... by room temperature water, a thorough washing of ... intermediate presulphonated wood does not inter...

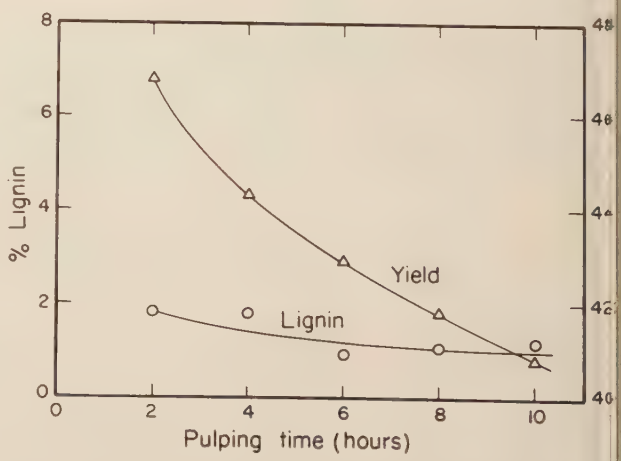

Fig. 14. Influence of time of pulping (temperature 120° on delignification of presulphonated hemlock

Wood presulphonated at room temperature in 10% SO_2 fo... weeks.

with subsequent pulping in a like acid. Thus when the wood was first soaked in 10% SO_2 solution for 2 weeks and the chips then washed by several overnight immersions and digested in a new 10% SO_2 solution at 120°C. for 8 hr., the lignin in the resulting pulp was 1.37% and the over-all yield 45%. These values compare with 1.44 and 46.5% respectively, when the intermediate washing was omitted.

PULPING OF LARGE WOOD UNITS

Ease of sulphonation throughout a 1-in. cube has been reported in an earlier paragraph. It is interesting that relatively large wood units can be sulphonated sufficiently at room temperature with a 10% SO_2 solution in a 2-week period to permit good pulping by the same 8-hr. cook as used for the smaller wood chips. This is evident from Table XI. In this particular set of experiments all except one chip design specified a $^3/_4$-in. length with the grain. Square cross sections were chosen in all cases and these ranged from $^1/_8$ up to 1 in. on an edge. Lignin and yield obtained were substantially as good with the $^1/_2$-in. units as with the smallest. Those $^3/_4$-in. blocks with 1-in. cross sections as well as the 1-in. cubes yielded pulp with somewhat higher lignin content but even these values are surprisingly low when compared with the lignin of a corresponding product that was made without presulphonation. All of the above again supports the viewpoint that the penetration of sulphur dioxide through the wood structure is rapid and that the results depend largely on rate of sulphonation under the low temperature conditions selected.

INFLUENCE OF LIQUOR CONCENTRATION

As shown in Fig. 11, concentration of sulphur dioxide in the presoak is very important in determining the extent of delignification realized in a following cook that is made in the same acid. This influence of sulphur dioxide concentration is also apparent in those cases where no presoak was practiced, but in such cases delignification is much less, at any concentration of cook acid, than when presoak is used. In one group of experiments a 3-week presulphonation was followed by the usual cook in the same liquor at 120°C. In the second group also shown in Fig. 11 the presulphonation stages were omitted. The data show clearly the important influence of presulphonation.

Figure 12 is equally interesting. In this particular instance, presoaks were done for 2 weeks. In one set, the sulphonation soaks were carried out with decreasing concentrations of sulphur dioxide ranging from 10 to 4% and then digested in a 4% SO_2 liquor. In the second set, the presoak was done with 4% SO_2 and the sulphonated wood products then digested in second solutions of decreasing concentrations. The figures show a consistently greater importance of second-stage liquor concentration. Thus, whereas a presoak with 4% SO_2 followed by a cook with 10% SO_2 resulted in a 2.1% lignin, the reverse sequence yielded a pulp having 13.8% lignin.

Table XIII. Influence of Wood Species on Sulphonation Followed by Pulping

In all cases: match-size wood chips; soaked in 10% SO_2 at room temperature; no intermediate washing; cook—120°C.—1 + 8 hr.

Wood species	*Original lignin, %*	*Soak time*	*Yield, %*	*Lignin, %*	*Original lignin removed, %*
Eastern spruce	29.6	18 hr.	45.2	9.2	86.0
Western hemlock	31.4	18 hr.	50.0	10.8	82.9
White birch	23.8	18 hr.	44.1	5.2	90.3
Southern pine	31.2	18 hr.	51.9	23.3	61.3
Douglas-fir	33.5	18 hr.	59.6	34.1	39.2
Eastern spruce	29.6	2 wk.	44.2	1.6	97.6
Western hemlock	31.4	2 wk.	46.5	1.4	97.9
White birch	23.8	2 wk.	43.4	3.4	94.1
Southern pine	31.2	2 wk.	45.2	8.7	87.6
Douglas-fir	33.5	2 wk.	49.7	23.8	64.7

INFLUENCE OF SOAK TEMPERATURE ON SUBSEQUENT PULPING

The higher degree of sulphonation reached at higher than room temperature as witnessed in Fig. 6 is reflected also in Fig. 13 which shows results of pulping in cases where presulphonations were made for three time periods and at three temperatures. Figures established with the 18-hr. pretreatments exaggerate the influence of the presulphonation temperature. Not plotted is a case in which a 2-week sulphonation was carried out at 0°C. followed by the usual pulping sequence. Here the resulting product had a lignin content of 13% as contrasted with 1.44% when the pretreatment was done at 30°C. This again emphasizes the importance of sulphonation before maximum cook temperature is reached.

TIME OF DIGESTION FOLLOWING PRESULPHONATION

Although for the most part experiments in this investigation specified an 8-hr. cook period at 120°C., a few experiments were made to demonstrate how these conditions could be changed without seriously affecting the net result.

In one set (Fig. 14) the maximum temperature of 120°C. was maintained but time periods were varied from 2 to 10 hr. Although the longer cooks show progressively lower lignin levels, it is noticeable that even in 2 hr., delignification has taken place to an extent which equals that found with most paper grade raw stocks. Yield advantage with the lesser time periods is also significant. A comparison 2-hr. cook made with

Table XII. Deactivation of Lignin by Prehydrolysis

Hemlock matches used; prehydrolysis at 130°C. in 1% SO_2 solution for 4 hr.; soak at room temperature in 10% SO_2 solution for 2 weeks; digestion at 120°C. in 10% SO_2 solution for 8 hr.

Prehydrolysis	*Soak*	*Intermediate wash*	*Digestion*	*Over-all yield, %*	*Sulphur, %*	*Lignin, %*	*Original lignin removed, %*
Yes	Yes	No	Yes	60.1	0.65	36.1	34.3
No	Yes	No	Yes	46.5	...	1.44	98.0
Yes	No	Yes	Yes	63.5	0.56	35.6	29.7
Yes	Yes	Yes	No	65.0	0.44	35.8	29.6

wood that had undergone no presulphonation yielded a poorly pulped product that contained 15.7% lignin.

INFLUENCE OF PULPING TEMPERATURE

In another set of experiments the presulphonated wood was cooked for the usual 8-hr. period but with different maximum temperatures (see Fig. 15). With 80°C. cook temperature, hardly any pulping occurred. Optimum temperatures are 110 to 120°C. At 130°C. yield is lower and lignin higher, indicating attack on cellulose and a partial deactivation of lignin. One can speculate that with a longer presulphonation, the 130°C. temperature could be used successfully if cooking time were shortened to avoid hydrolysis of cellulose. Such an experiment has not been done.

DEACTIVATION OF LIGNIN BY PREHYDROLYSIS

Earlier experiments had shown that high temperature pretreatment with water and with weak sulphur dioxide solution interferes with normal sulphonation when the pretreated wood is then soaked in 10% SO_2 at room temperature. This deactivation of lignin was further demonstrated by an experiment in which the wood was first digested in a 1% SO_2 solution at 130°C. for 4 hr. and washed. At this stage, sulphur was found to be 0.37%. The washed product was then soaked in 10% SO_2 solution for 2 weeks with a resulting sulphur content of 0.47%. Digestion with 10% SO_2 followed at 120°C. No pulping occurred. Table XII shows that a corresponding case with no prehydrolysis gives normal pulp. All of the above confirms the viewpoint that the activity of the deactivated lignin is not fully restored by long time low temperature sulphonation, but one must note that 34% of the original lignin was ultimately solubilized indicating either that it had escaped deactivation or had been reactivated in the subsequent stages. Such reactivation must have been slight, since it was shown in a third experiment that when the 2 week soak period was omitted, the final digestion of the prehydrolyzed wood resulted in a 30% lignin removal.

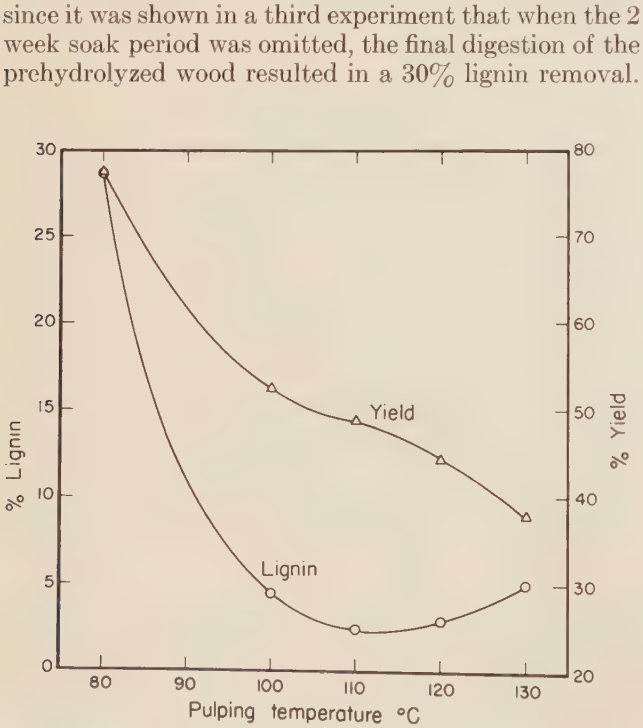

Fig. 15. Influence of pulping temperature on delignification of presulphonated hemlock

Pulping time 8 hr. Wood presulphonated at room temperature in 10% SO_2 for 2 weeks.

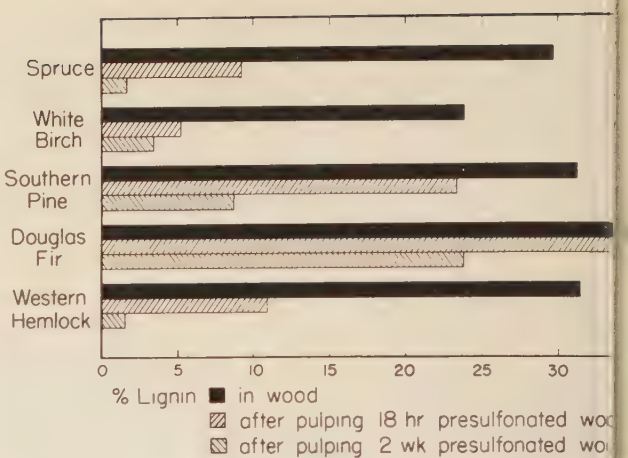

Fig. 16. Influence of wood species on ease of pulp presulphonated wood

Presulphonation in 10% SO_2 at room temperature. Pulp in 10% SO_2 at 120°C., 8 hr.

It can be shown that a high temperature pretreatm with water or with weak sodium hydroxide solut follows this same pattern when the prehydroly chips are then sulphonated and digested as indica above.

INFLUENCE OF WOOD SPECIES

Douglas-fir, southern pine, and to a lesser exte white birch behave differently than hemlock and spr when the presulphonation → digestion sequence is us This is shown in Table XIII and in the bar chart Fig. 16.

With an 18-hr. presulphonation and the sec stage digestion in the sulphur dioxide solution, it seen that over 80% of the original lignin is extra from the spruce, the hemlock, and also the bi whereas the pine loses only 60% and the Dougla 40%. With a 2-week presulphonation, the same g eral relationship holds except that the birch p retains about twice as much lignin as is found w spruce or hemlock even though the per cent remova almost as high. This higher lignin residue with bi probably relates to the lesser degree of sulphonatio the presoak (see Table IX) and suggests that this w species contains a small percentage of less react lignin which carries through. Similar work with ot deciduous woods will prove interesting. Such a p gram should also consider the influence of age of w after cutting.

Table XIII does not include a few experiments which a solvent extracted Douglas-fir was presoal for 2 weeks and then digested. Lignin in such p showed a somewhat lower level (18.4 versus 2 indicating only limited influence of solvent extra ables.

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ASSOCIATION NEWS AND EVENTS

Local Section Meetings

New England: Oct. 8–9, 1954, Berkshire Inn, Great Barrington, Mass.

Maine-New Hampshire: June 18–19, 1954, Marshall House, York Harbor, Me.

National Conferences

Third Statistics Conference: July 12–24, 1954, University of Maine, Orono, Me.

Fundamental Research Conference: Sept. 21–24, 1954, Institute of Paper Chemistry, Appleton, Wis. "Fundamentals of the Paper Machine."

Testing Conference: Oct. 6–8, 1954, The Dayton Biltmore, Dayton, Ohio.

Eighth Alkaline Pulping Conference: Oct. 6–8, 1954, Dinkler-Tutweiler Hotel, Birmingham, Ala.

Ninth Engineering Conference: Oct. 18–21, 1954, Benjamin Franklin Hotel, Philadelphia, Pa.

Corrugated Containers Conference: Nov. 17–19, 1954, De Soto Hotel, Savannah, Ga.

Fibrous Agricultural Residues Conference: Nov. 8–9, 1954, Northern Regional Research Laboratory, Peoria, Ill.

Inspection of Digesters

TAPPI Monograph No. 12, "Inspection of Digesters," was issued recently under the sponsorship of the Digester Corrosion Subcommittee of the Chemical Engineering Committee.

This monograph differs from its predecessors in that it is to a large extent a manual to guide inspectors who will continue to study the digester corrosion problem. The manual presents a definition of the functions of a digester inspector, and a description of recommended practices for carrying them out.

The Association is indebted to the following individuals who prepared the various chapters of the monograph:

P. K. Bloch, Branson Instruments, Inc., Stamford, Conn.
H. M. Canavan, Mutual Boiler & Machinery Insurance Co., Boston, Mass.
T. E. Caywood, Caywood-Schiller Associates, Chicago, Ill.
R. A. Davis, Chicago Bridge & Iron Co., Birmingham, Ala.
F. W. Flynn, Crown Zellerbach Corp., Camas, Wash.
J. J. Goss, Gaylord Container Corp., Bogalusa, La.
R. A. Huseby, A. O. Smith Corp., Milwaukee, Wis.
E. W. Hopper, Crucible Steel Co. of America, Pittsburgh, Pa.
F. E. Hutton, Babcock & Wilcox Co., New York, N. Y.
J. R. Lientz, Union Bag & Paper Corp., Savannah, Ga.
W. B. Parker, Hartford Steam Boiler & Inspection Co., Hartford, Conn.
H. F. Peters, Lukens Steel Co., Coatesville, Pa.
M. A. Scheil, A. O. Smith Corp., Milwaukee, Wis.
E. H. Schmidt, A. O. Smith Corp., Milwaukee, Wis.
W. J. Shelton, Longview Fibre Co., Longview, Wash.
N. Shoumatoff, West Virginia Pulp & Paper Co., New York, N. Y.
C. W. Smith, Crosset Paper Mills, Crossett, Ark.
F. B. Snyder, Babcock & Wilcox Co., Alliance, Ohio
H. O. Teeple, International Nickel Co., New York, N. Y.
B. Thomas, Stebbins Engineering & Mfg. Co., Watertown, N. Y.
J. M. Wilcox, Electric Steel Foundry Co., Portland, Ore.

Many other individuals and companies assisted the Digester Corrosion Subcommittee in the work which led to the preparation of this monograph.

British Technical Section

The Sixty-Eighth General Conference of the Technical Section of the British Paper and Board Makers' Association will be held at the Midland Hotel, Manchester, England, on Oct. 27, 1954.

Foreign Operations Administration

J. H. Davis, project manager of the Industrial Technical Assistance Div. of the Foreign Operations Div., Washington D. C., writes as follows:

The Foreign Operations Administration wishes to express to the Technical Association of the Pulp and Paper Industry its appreciation and thanks for the wholehearted cooperation, hospitality, and unselfish giving of time and experience to the gentlemen from Norway who recently completed their visit in the United States.

FOREIGN OPERATIONS ADMINISTRATION

CERTIFICATE OF COOPERATION

awarded to

TECHNICAL ASSOCIATION OF THE PULP & PAPER INDUSTRY

for furnishing technical assistance to the peoples of friendly countries cooperating to maintain individual liberty, free institutions and peace.

Harold E. Stassen
Director of Foreign Operations

Their comments before leaving for home were indeed gratifying, and we feel it was only such cooperation and assistance as your organization gave that made their visit one of the most successful undertakings in the program to increase productivity and to strengthen the mutual security of the free world.

We are presenting to the Association our Certificate of Cooperation as a token of our appreciation for the courtesies extended to this program.

Worthen E. Brawn Award

The TAPPI Maine-New Hampshire Section has established an annual prize to be designated as the Worthen E. Brawn Memorial Award.

Worthen E. Brawn (deceased) was president of the Technical Association in 1947 and was one of the principal organizers of the Maine-New Hampshire Section. He was also vice-president of the Pejepscot Paper Co. in Brunswick, Me.

The competition will be open to college students who are residents of northern New England and to all young people in these states who are actively engaged in some phase of the

pulp and paper industry. A monetary award may be made to two individuals each year who present papers judged to be the best papers offered in the competition.

Lowell Technological Institute

A two-week Summer course in "Paper—Its Properties and Uses" will be given by the Department of Paper Engineering at the Lowell Technological Institute, Lowell, Mass., from June 21 to July 2, 1954.

John Lewis, Norwood H. Keeney, and William Bond Wheelwright will be the instructors.

The course will cover pulp and paper manufacture, papermaking, paperboard making, testing, paper and board classification, papermaking arithmetic and cost calculations, printing inks, cordage, economics of paper sales, and paper problems from the sales angle. The course is endorsed by the Boston Paper Trade Association.

Association Committees

R. G. Lacey of the Celotex Co. has succeeded Edward M. Jenkins as chairman of the TAPPI Structural Fibrous Materials Committee. Thure C. Duvall of the Wood Conversion Co., Cloquet, Minn., was originally selected as the successor of Mr. Jenkins but died soon after the recent Annual Meeting of the Association. J. J. Perot of the Flintkote Co., Whippany, N. J., has been appointed secretary of the committee.

John M. MacBrayne of the Union Bag & Paper Corp., Savannah, Ga., has been appointed chairman of the new Industrial Engineering Committee in the TAPPI Engineering Div.

The TAPPI Training and Education Committee has been transferred to inactive status because of lack of interest on the part of any individual to assume the chairmanship. The committee under the chairmanship of J. H. Groves of the Union Bag & Paper Corp. made an excellent start on a sound program of value to the training supervisors of the industry. The intent of the program was to focus attention of the pulp and paper industry on the best training practices in the industry. Professional work of this kind is generally under the direction of individuals who are not members of the Technical Association. The Training and Education Committee will be revitalized when interest again develops on the part of Association members.

TAPPI Engineering Division

Following is the current roster of officers of the Engineering Division.

C. J. Sibler, West Virginia Pulp & Paper Co., New York, N. Y., General Chairman
J. D. Lyall, Armstrong Cork Co., Lancaster, Pa., Vice-Chairman
W. C. Bloomquist, General Electric Co., Schenectady, N. Y., General Secretary

Chemical Engineering Committee

J. R. Lientz, Union Bag & Paper Corp., Savannah, Ga., Chairman
H. O. Teeple, International Nickel Co., New York, N. Y., Secretary

Digester Corrosion Subcommittee

N. Shoumatoff, West Virginia Pulp & Paper Co., New York, N. Y., Chairman

Data Sheets Committee

J. W. Hemphill, Johns-Manville Corp., New York, N. Y., Chairman
A. J. Winchester, TAPPI, New York, N. Y., Secretary

Drying and Ventilating Committee

Curt A. Young, Riegel Paper Corp., Milford, N. J., Chairman
R. M. Cook, Midwest-Fulton Machine Co., Dayton, C
Secretary

Electric Engineering Committee

R. W. Foster, Champion Paper & Fibre Co., Canton, N.
Chairman
J. L. Van Nort, Reliance Electric & Engineering Co., Cl
land, Ohio, Secretary

Engineering Research and Machine Design Committ

R. G. Quinn, Johns-Manville Research Corp., Manville, N
Chairman
R. D. Irwin, Brown Instrument Co., Philadelphia, Pa., Se
tary

Hydraulics Committee

K. J. Mackenzie, Eastman Kodak Co., Rochester, N.
Chairman

Industrial Engineering Committee

J. M. MacBrayne, Union Bag & Paper Corp., Savannah,
Chairman

Materials Handling Committee

W. R. McNally, Link-Belt Co., Pittsburgh, Pa., Chairma
H. A. Stoess, Jr., Fuller Co., Catasauqua, Pa., Secretary

Mill Maintenance and Materials Committee

G. F. Hrubecky, Marathon Corp., Menasha, Wis., Chairma
H. K. Kingsbury, Allis-Chalmers Mfg. Co., Norwood, C
Secretary

Mill Planning and Economics Committee

R. A. Packard, Takoma Park, Md., Chairman
P. A. Forni, Mohawk Paper Mills, Inc., Cohoes, N. Y., Se
tary

Steam and Power Committee

W. Wyburn, Federal Paper Board Co., Inc., Bogota, N.
Chairman
J. Gottlieb, Westinghouse Electric Corp., 40 Wall St.,
York, N. Y., Secretary

Ninth Engineering Conference

Plans for the Ninth Engineering Conference of the Te
cal Association are proceeding at a satisfactory r
Monthly meetings are being held by the Committee in ch
of Local Arrangements.

The members of the local committee are as follows:

J. C. Harper, Jr., Downingtown Mfg. Co., Downingtown, Co-chairman
Edward J. Albert, Thwing-Albert Instrument Co., Philadelp
Pa., Co-chairman
C. H. Rice, Westinghouse Electric Corp., Philadelphia, Secretary and Treasurer
F. J. Lovegren, P. H. Glatfelter Co., Spring Grove, Pa.
Emil R. Padavic, Container Corp. of America, Manayu
Pa.
John R. Curtis, Scott Paper Co., Chester, Pa. (Arrangeme
John D. Lyall, Armstrong Cork Co., Lancaster, Pa.
William Kurlish, General Electric Co., Philadelphia, Pa.
Robert C. Riding, Container Corp. of America, Manayu
Pa.
Henry S. Dimmick, SKF Industries, Inc., Philadelphia, (Registration)
Emerson N. Glaunen, Jr., Downingtown Mfg. Co., Down
town, Pa.
Philip H. Goldsmith, Pusey & Jones Corp., Wilmington, De

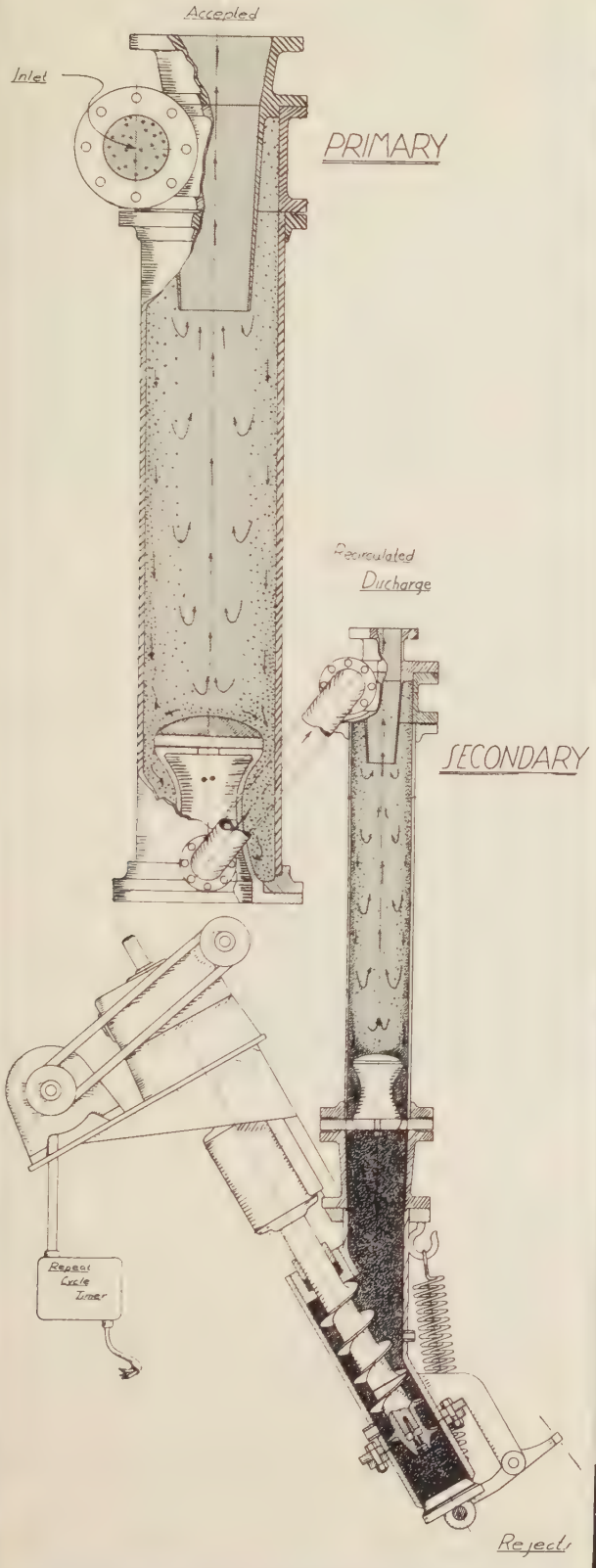
The committees of the Engineering Division are prepa
the programs of the various technical sessions.

Features of the meeting, aside from the technical progr
include an official visit to the mill of the Scott Paper Co
Chester, Pa. The after-dinner speaker will be James Q.
Pont of E. I. du Pont de Nemours & Co., Inc., Wilmingt
Del., who will give his interesting talk on human relatio
The speaker at the Engineering Division luncheon will
H. W. Prentis, Jr., chairman of the Armstrong Cork C

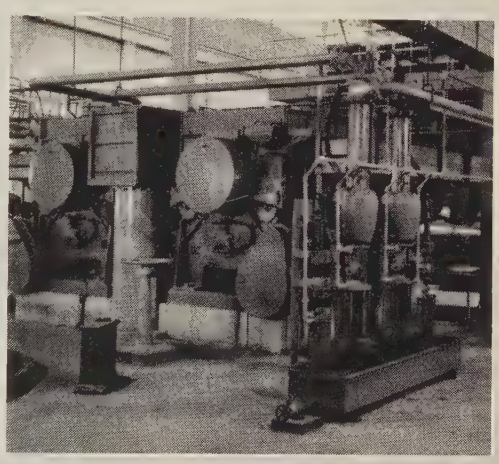
BIG JOBS OR SMALL

THE DIRTEC BEATS 'EM ALL

— when it comes to thorough separation and complete removal of dirt from stock



The "King Size" Dirtec (12″ primary and 4″ auxiliary) has a capacity of 1400 gallons per minute. This cross section sketch shows how it works when handling big volumes of heavy, coarse dirt taken out of board stock. It may be equipped with a continuous dirt evacuator, as shown.



These Dirtecs, with 6″ primary and 2″ auxiliary, are applied to Bird Screen tailings, one Dirtec unit per Screen, and handling up to seven tons of screen rejects per day.

Dirtecs are extraordinarily effective, dependable and economical whether used on pulp or board stocks, ahead of the paper machine on all grades of stock, or as tailings units for Bird Screens.

BIRD MACHINE CO.

SOUTH WALPOLE, MASS.

Lancaster, Pa. Mr. Prentis was formerly president of the National Association of Manufacturers and is an excellent speaker. The Westinghouse Chorus will present several selections at the dinner meeting on October 19.

The Ninth Engineering Conference will be held at the Benjamin Franklin Hotel, Philadelphia, Pa., on Oct. 18–21, 1954.

Letter Ballot on Standards

The following tentative standards and recommended practices were recently submitted to the voting members of the Technical Association for their consideration:

For Advancement from Tentative to Official Standard:
T 222 m-50, Acid-Insoluble Lignin in Wood Pulp.
T 462 m-43, Printing-Ink Permeability of Paper.
T 470 m-47, Edge Tearing Resistance of Paper (Finch Method).

Proposed revision of Official Standard:
O 400 p-44, Standard Terms Used in the Sulphate Pulping Process.

As a result of this mail ballot, the following methods have been advanced to official standard status:

T 222 m-50, Acid-Insoluble Lignin in Wood Pulp.
T 470 m-47, Edge Tearing Resistance of Paper (Finch Method).

Objections were offered relative to the other two as follows:

T 462 m-43

1. Suggest use of 73°F. for oil (standard humidity room conditions) or use another oil having desired properties at 73°F.

2. Unrealistic, regardless of forced apparent correlation. No drop of castor oil, or other oil, used in the manner suggested, can simulate the conduct of the exceedingly thin film of pigmented oil (ink) deposited by a printing press on a paper.

3. The determination is dependent on what an observer "thinks" is "uniform" and "maximum" translucency in judging the oil spot. To obtain a satisfactory TAPPI Standard a more decisive end point (measured by an instrument if possible), is indicated.

There is considerable question about the degree to which castor oil correlates with printing ink experience. (Where is the evidence to justify using castor oil? Some in industry prefer water, others glycerine, and various other compounds that penetrate at more nearly the rates of printing ink.)

There are sufficient other variations in the test (too wide a temperature band 3.5°F.) that frequently large variations in the same grade paper are less than the variation of one experienced observer from one time to another. Sometimes variations in formation and surface cause results to be difficult to evaluate.

In the absence of an official standard, the test is useful, but not of sufficient quality to be considered a TAPPI Standard. It should remain tentative.

4. The title is too broad. We believe there is sufficient evidence to show that a castor oil test is applicable only as a measurement of printing ink penetration of *relatively absorbent* printing paper. Secondly, it is not applicable on papers that are two-sided in respect to ink and oil absorbency.

The method described actually gives the time required to completely saturate the test sample with castor oil. Printing ink vehicle penetrates only part way into the sheet. Since the test method involves both surfaces of the test sample, as compared with the printing process which involves only the side printed, the results do not always agree.

5. Box description is not clear. Should be accompa by drawing showing dimensions and arrangement.

6. Section 2, under *Apparatus*, last line—tempera should conform with T 205 m; 73 ± 3.5°F. (*Ed. n* Probably T 402 m was meant instead of T 205 m.)

O 400 p-44

1. (a) Total Chemical: I believe that the expres "total chemical" should *not* include those sodium compou in which the sodium is completely unavailable for the purp concerned, for example, NaCl (and KCl); possibly als should not include compounds like sodium silicate, etc. main objection here, of course, is to NaCl which may be p ent in appreciable quantities, which is absolutely inert f any ordinary viewpoint, and which in numerous insta comes largely from chlorides in the mill water supply. A body who has ever had to wash pulp with water contamina with sea water, or with appreciable quantities of chlor from any other source, knows what I mean. I am assum of course, that the term "total chemical" refers not onl salt cake substitutes, but also to black liquor, green liq white liquor, et cetera.

(b) I am wondering why the term "$^1/_2$ Na_2SO_3" is not included under Item (3).

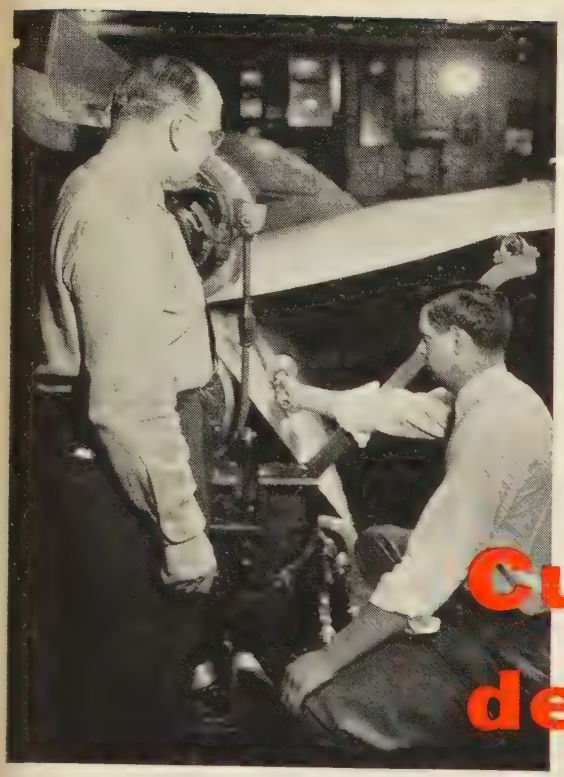
(c) Causticity: I object emphatically against this us the term "causticity" for this item because at many m they still use this term as though it were synonymous w the term "activity." I would like to see the term "caus ity" dropped altogether. If we use the term "caustic with the meaning arbitrarily given to it in the present, o the proposed, version of O 400 p-44, it only confounds confusion. Why not call this "per cent caustic soda" some similar nonobjectionable, self-defining term?

(d) Sulphidity: I also register an emphatic objectio the proposed definition of this term because, from the ginning of the sulphate industry in the United States, the majority of the pulp produced by the sulphate proces the United States has been made in mills which have alw defined (and which will continue to define) sulphidity as percentage ratio of Na_2S, expressed as Na_2O, to total a expressed as Na_2O." Changing the United States defi of "sulphidity" at this late date in order to conform wit present Canadian definition, would simply increase and found the confusion, et cetera, that already exists in the m ter.

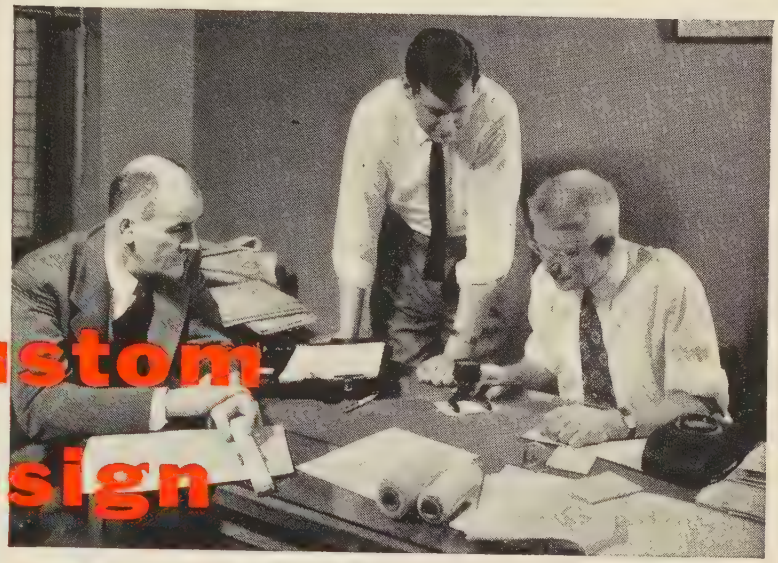
(e) Unreduced Salt Cake: I would define this term proximately as follows: "Na_2SO_4 in the green liquor, pressed both as Na_2O and as Na_2SO_4, but corrected for Na_2SO_4 introduced into the green liquor from other sour such as with the white liquor wash liquors from the cau room." It has long surprised me that, apparently, m competent experienced chemists and chemical engineers the sulphate industry still do not realize that a large por of the actual Na_2SO_4 in the white liquor stems from w happens in the lime kiln and that, for this reason, part of actual Na_2SO_4 present in the green liquor is the direct re of Na_2SO_4 so produced and added as make-up, in the for white liquor, wash liquors, et cetera, from the caustic roo the smelt dissolving tanks at the recovery furnaces.

(f) Make-up chemical consumption: On account of importance of sulphur and sulphur compounds in the sulph process, I feel that the make-up figures should show not c the pounds of Na_2SO_4, and/or other sodium compounds, pressed as Na_2SO_4, added as new chemicals per ton of air- pulp produced but also the elemental sulphur, and/or sulp compounds (including Na_2SO_4) expressed as S, added as chemicals per ton of air-dry pulp produced.

(g) Chemical recovery: For reasons hinted at under I feel that the term "chemical recovery" should be define terms of both sodium and sulphur. The recovery of b sodium and sulphur is extremely important. Sodium sulphur losses are very important for many reasons, includ



Teamwork...



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The Huyck custom design operation is sparked by a Huyck field serviceman. Experienced and capable, he works with you on your felt requirements, then transmits this exact information to the Huyck designers.

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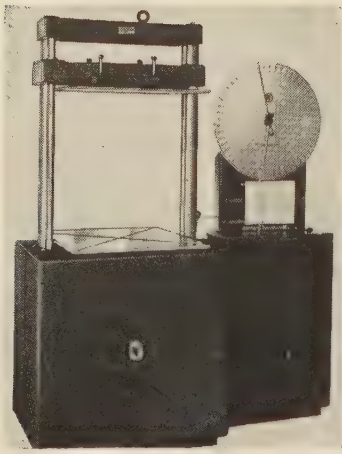

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Reasonably Priced

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5000-lb. Machine

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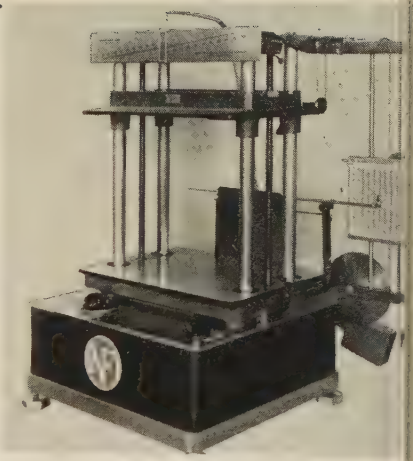
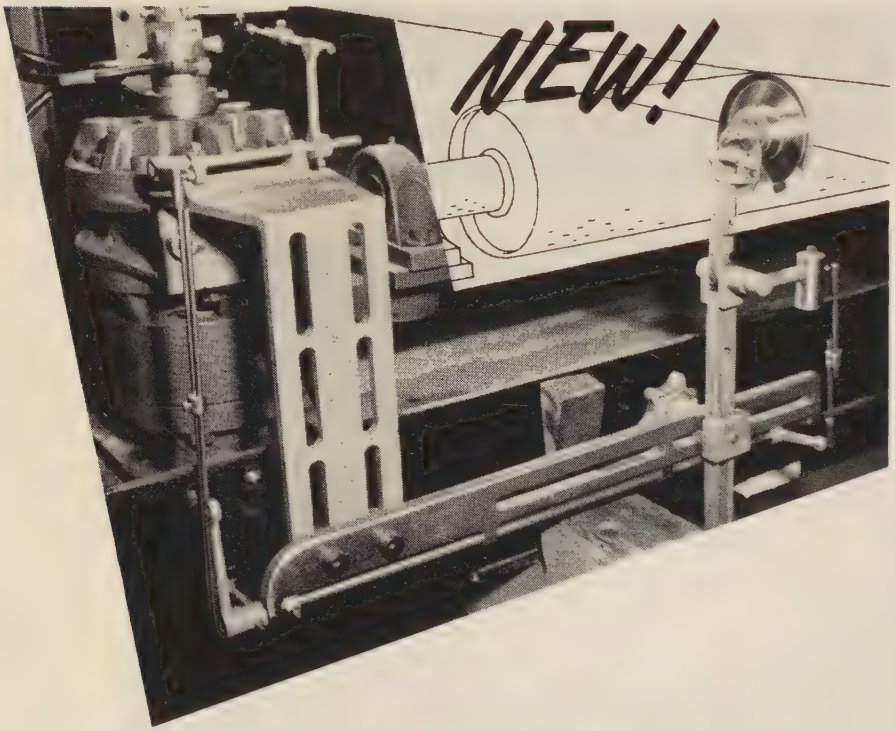
NATIONAL FORGE & ORDNANCE CO.
Irvine, Warren County, Pa.
Testing Machine Div.





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New Rotary Palm Blade for wire service is engineered to travel true *without wobbling or shimmying.* This basic improvement extends life of the blade, prolongs life of wire edge. Unit features SKF 6201Z sealed bearing and is adaptable to present palm assemblies. Write our representative for more facts today . . . you'll find it a rewarding experience.

*patent applied for

GILBERT and NASH company

APPLETON, WISCONSIN

with regard to waste disposal (the liq wastes contain both sodium and phur; the sulphur losses are the ca of the kraft mill odor problem). I sure, also that you appreciate the deg to which some people in Washing frowned on the use of elemental phur in the sulphate process during recent sulphur shortage period.

Chemical loss: (g) above also plies to parts (a), (b), (c), and (d) un Item (13).

2. There seems to be some confus in the use of certain terms, which not at all in conformity with the gen acceptable terminology; total che cal, active alkali, causticity, sulphid make-up chemicals.

3. Should have uniformity w OPPA and foreign organizations; v confusing at present, and this is s ous.

4. I am voting *no* on the basis no. 6, causticizing efficiency, whic think is meaningless as expressed though better than the old definiti I think that causticizing efficie should be expressed as per cent of th retical based upon the equation Hughey, Herndon, and Withrow. a term for per cent of theoretical w introduced, then I would be perfec satisfied.

5. In Item 2 should $^1/_2Na_2SO_3$ Na_2SO_4?

6. Believe sulphidity should be pressed as Na_2S divided by total alk Have referred to this often in alkal pulping meetings and correspondence

7. Confusion of terms.

8. Neither causticity nor causti ing efficiency take into account possible discrepancy arising from hydrolysis of Na_2S to NaSH and NaO Even at the high alkali contents green and white liquors, a certain p centage (according to the literature) Na_2S is hydrolyzed. Also in terms volving chemical losses, why can't th be put on a tons of pulp basis?

Because a Paper Plant needed help...

Foam was causing the dandy roll in a midwestern plant to pick up large quantities of both water and stock. Called in for help, a member of Nopco's technical staff sprayed Nopco® KFS on the wire in a solution, one lb. per ton of paper. The stock ceased to pick up; the water was reduced to a fine spray. So impressive was the demonstration, they hastily called the firm's president from a conference to "come and see." Naturally, the plant has now standardized on KFS.

☆ ☆ ☆

The technical service men of Nopco's Paper Division have just one mission in life—to help you. They'd be excellent men for you to know.

It may well be that some obstacle in efficient sizing, or foam dispersal, or pitch control, which has your staff stumped right now, is one that our laboratory removed only last month for some manufacturer a thousand miles from you.

In the pilot plant in Nopco's Research Laboratories, these men work constantly (when they're "at home") on practical problems submitted to them from mills the country over. They don't know all the answers yet, but they have helped many plants to produce a better sheet of paper, at lower cost.

Nopco was founded on research. It has grown to its present position by research—which simply means finding new and better ways to do things which need doing. But the knowledge thus gained, after all, does us little good until we share it with you. Our technical men are our medium of sharing it. Put your toughest problem up to them. Why not do it today?

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Plasticizers • High Free Rosin Sizes • Pitch Dispersants.

PERSONAL MENTION

Items About New and Old Tappimen

New TAPPI Members

George A. Adamson, Technical Director, Philippine Paper Mills, Inc., Manila, Philippines, a 1930 graduate of the University of Athens.

John H. Allen, Assistant Supervisor and Technical Service Engineer, Kraft Mill, Oxford Paper Co., Rumford, Me., a 1947 graduate of New York State College of Forestry.

William F. Aloisi, Jr., Technical Trainee, Gardner Board & Carton Co., Middletown, Ohio, a 1953 graduate of New York State College of Forestry.

Alexander Baczewski, Chemist, Arvey Corp., Jersey City, N.J., a 1937 graduate of the University of Vienna with a Ph.D. degree.

Raymond P. Basso, Assistant Superintendent, Michigan Carton Co., Battle Creek, Mich., a 1949 graduate of the University of Michigan.

Edwin L. Bates, Plant Engineer, Portco Corp., Vancouver, Wash., a 1947 graduate of California Aero Technical Institute.

Klaas R. Bes, Cellulose Adviser to the Government of Israel, United Nations, New York, N. Y., a 1940 graduate of the Technical University, Delft.

Henry L. Bottemiller, Pacific Northwest Representative, Titanium Pigment Corp., Portland, Ore., a 1934 graduate of North Dakota State College.

Joseph A. Boyle, Student, Western Michigan College, Kalamazoo, Mich.

Thor W. Brehmer, Salesman, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., a 1942 graduate of Harvard University.

Jean M. E. Brown, Librarian, Dominion Tar & Chemical Co. Ltd., Montreal, P. Q., Canada, a 1948 graduate of the University of Toronto.

Howard J. Buechler, Sales Engineer, The Black-Clawson Co., Hamilton, Ohio, a 1948 graduate of Purdue University.

Harry M. Burnette, Maintenance Superintendent, National Container Corp., Valdosta, Ga.

Frank T. Coldwell, Field Engineer, Elliott Co., Jeannette, Pa., a 1950 graduate of the University of Wisconsin.

Norman C. Cowie, Mill Manager, Ste. Anne Paper Co. Ltd., Beaupre, P. Q., Canada, a 1931 graduate of the University of Toronto.

Robert E. Crowe, Student, Lowell Technological Institute, Lowell, Mass.

Charles F. Dexter, Sales Engineer, Cochrane Steam Specialty Co., Boston, Mass., a 1936 graduate of the University of Maine.

Edward L. Dozier, Pulp Mill Superintendent, The Chesapeake Corp. of Virginia, West Point, Va., a 1936 graduate of William and Mary College.

Frank A. Fedele, Superintendent, Waxon-Carboff, Inc., Rochester, N. Y. Attended the Rochester Institute of Technology.

Olga de Toledo Fonseca, Librarian, Instituto de Pesquisas Tecnologicas, Brazil, S. A.

Karl Freudenberg, Professor of Chemistry, University of Heidelberg, Chemical Institute, Heidelberg, Germany, a 1910 graduate of the University of Bonn with a Ph.D. degree.

Jose J. Garciduenas, Superintendent, Cia. Industrial de Atenquique, S. A., Jalisco, Mexico, a 1947 graduate of the University of Mexico.

Charles W. Gould, Industrial Consultant, New York, N. a 1927 graduate of Leland Stanford University.

Rudolph N. Griesheimer, Research Director, The M Corp., Chillicothe, Ohio, a 1937 graduate of Miami Univers

John R. Guilliams, Special Representative, The Goody Tire & Rubber Co., Inc., Hartford, Conn., a 1948 graduat Northwestern University.

Felix M. Hammack, Development Engineer, The Buck Cotton Oil Co., Memphis, Tenn., a 1953 graduate of Louisi Polytechnic Institute.

Rowland T. Hanger, Division Manager, Robert Gair Inc., Teterboro, N. J.

Francis P. Haszard, Assistant Manager, Bonar & Be Ltd., Vancouver, B. C., Canada, a 1942 graduate of Royal Military College of Canada.

Charles L. Hoebel, Field Engineer, Elliott Co., New Y N. Y., a 1941 graduate of Worcester Polytechnic Institut

George N. Holme, Research Chemist, Stone Conta Corp., Chicago, Ill., a 1949 graduate of the University Tennessee.

R. Max Hubmeier, Consulting Engineer, Pforzhe Germany, a 1938 graduate of the Technical Univers Karlsruhe.

Hideo Ito, Chief Engineer, Fuji Photo Film Co., Imaiz Factory, Shizuoka-ken, Japan, a 1924 graduate of Was University.

Peter K. Jung, Engineer, Biffar & Jung, Miltenberg/M Western Germany, a graduate of O. v. Miller Polytec College.

Satoru Kakumoto, Director, Technical Div., Nihon Shi Kabushiki Kaisha, Geibo Mill, Hiroshima-ken, Japan, a 1 graduate of Kyoto Technical College.

Gordon H. Kettering, Chief Staff Engineer, The Mead Co Kingsport, Tenn., a 1949 graduate of Ohio State University

John A. Kilroy, Sales Engineer, Heppenstall Co., Pi burgh, Pa. Attended the University of Pittsburgh.

Hans Klingelhoeffer, Director of Research, Papiertechnis Stiftung, Munich, Germany, a 1942 graduate of the Techn University, Darmstadt, with an Eng.D. degree.

John E. Knecht, Plant Engineer, Shipping Containers L Montreal, P. Q., Canada, a 1948 graduate of McGill Uni sity.

Erich A. Kraemer, Packaging Engineer, Zellstofffal Waldhof, Mannheim-Rheinau, West Germany.

Gunnar E. Krause, Managing Director, Finlands Met duksvaeri AB, Malm, Finland, a 1925 graduate of the Te nical University, Dresden.

Paul Lagally, Research Chemist, Linden Laborato State College, Pa., a graduate of the Technical Univers Dresden, with an Eng.D. degree.

Thomas A. Likos, Consulting and Application Engin Westinghouse Electric Corp., Boston, Mass., a 1942 gradu of Northeastern University.

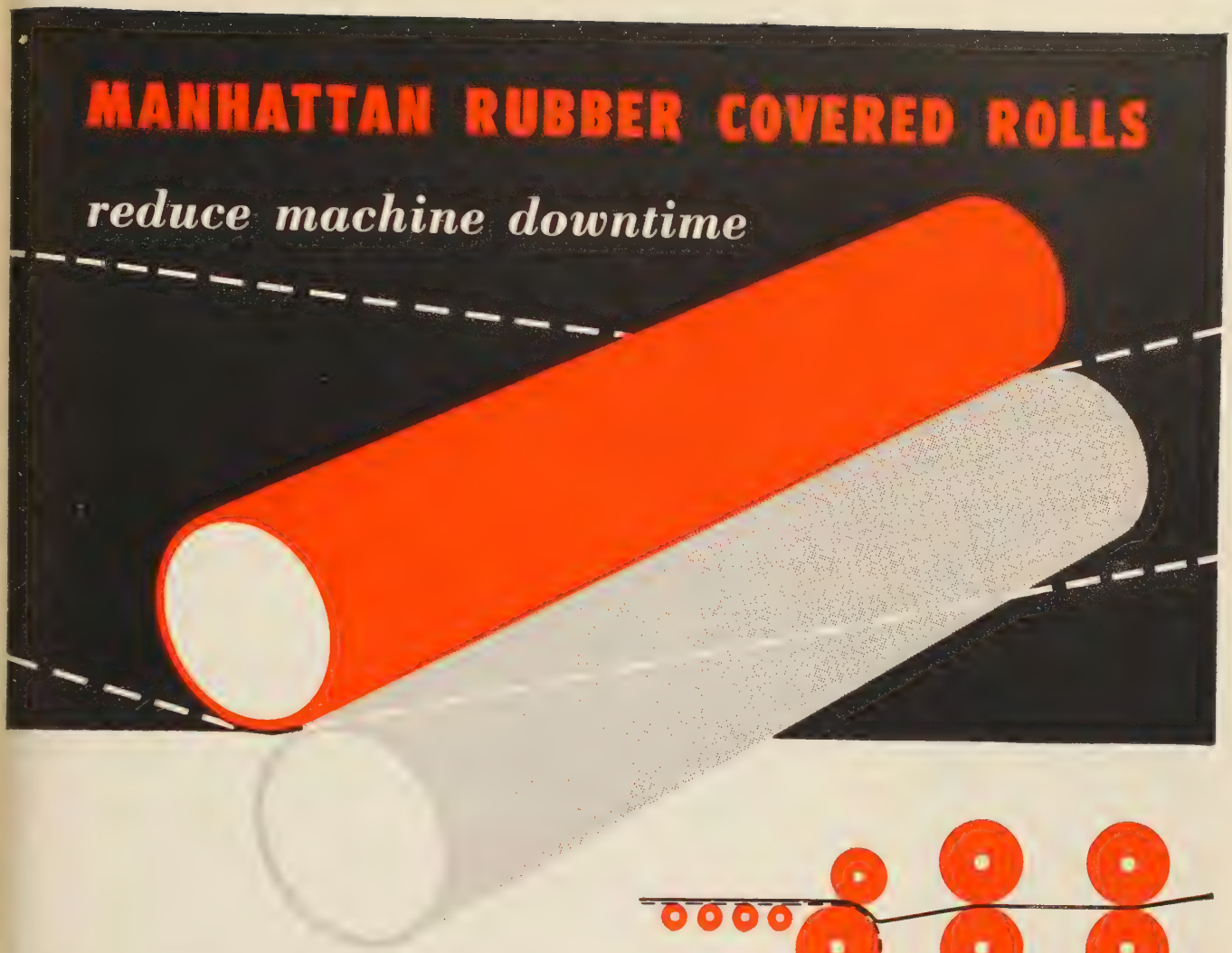
Vincent A. Long, Technical Director, Blandy Paper Greenwich, N. Y., a 1935 graduate of the University Illinois.

Ian C. MacGugan, Chemical Engineer, Buffalo Elect Chemical Co., Inc., Buffalo, N. Y., a 1949 graduate of University of Toronto.

William E. Mann, Chemist, Champion Paper & Fibre C

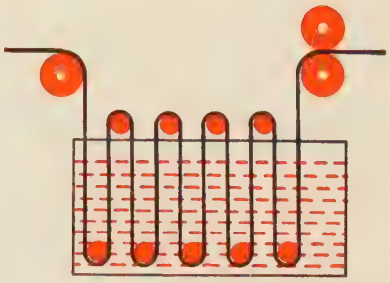
MANHATTAN RUBBER COVERED ROLLS

reduce machine downtime



give you

more use per dollar



Cracking, hardening, corrugation, or separation of rubber from the metal roll core all spell "trouble" for rubber roll coverings . . . and losses in production, quality and schedules. Manhattan roll specialists have eliminated these causes of expensive machine downtime to give you "More Use per Dollar" with Manhattan Rubber Covered Rolls. They have developed an inseparable bond of rubber to metal. They custom-tailor rubber roll covering to meet your specific requirements. You get permanent uniform and correct density and uninterrupted high speed production runs under all working conditions. Discuss your operating requirements with an R/M roll engineer.

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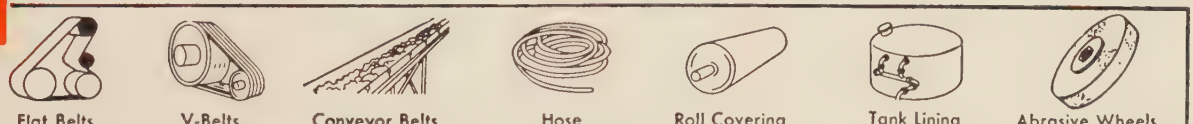

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RM 421

Hamilton, Ohio, a 1953 graduate of the University of Cincinnati.

William J. Marshall, Technical Director, Insulation Board Institute, Chicago, Ill., a 1941 graduate of Harvard University.

Donald J. McAnulty, Layout Drawing, Beloit Iron Works, Beloit, Wis., a 1950 graduate of the University of Minnesota.

Jaye A. McKenney, Student, University of Maine, Orono, Me.

Charles R. Merriman, Chemist, The Gardner Board & Carton Co., Middletown, Ohio, a 1923 graduate of the University of Wisconsin.

Marvin G. Mitchell, District Sales Manager, Chicago Bridge & Iron Co., Atlanta, Ga., a 1939 graduate of Georgia Institute of Technology.

Ignacio G. Morphy, Chief Chemist, Cia. Industrial de Atenquique, S. A., Atenquique, Jalisco, Mexico, a 1948 graduate of the University of Mexico.

Jose J. Najar, Assistant Paper Mill Superintendent, Cia. Industrial de Atenquique, S. A., a 1943 graduate of Mendelejeff Chemical Institute.

Jerome S. Newland, Vice-President in Charge of Formulations of Petroleum Wax, Industrial Raw Materials Corp., New York, N. Y., a 1932 graduate of Harvard University.

Bruce S. Nicholas, Technical Assistant, International Business Machines Corp., Greencastle, Ind., a 1949 graduate of Rutgers University.

Harold E. Orford, Acting Chairman, Dept. of Sanitation, Rutgers University, New Brunswick, N. J., a 1936 graduate of Case Institute of Technology.

Roy E. Peach, Process Engineer, Rayonier, Inc., Jesup, Ga. a 1947 graduate of the University of Colorado.

Lyle L. Phifer, Research Chemist, American Viscose Corp., Marcus Hook, Pa., a 1948 graduate of Wofford College, with a Ph.D. degree from Vanderbilt University in 1953.

Howard M. Phillips, Manager, Quality Control Dept., Doeskin Products, Inc., Rockland, Del., a 1944 graduate of the University of Pennsylvania.

Joseph Phillips, Research Chemist, Daugherty Refinery, Div. of L. Sonneborn Sons, Inc., Petrolia, Pa., a 1937 graduate of the University of Pittsburgh with a Ph.D. degree.

Andrew L. Pickens, Jr., Staff Engineer, Buckeye Cellulose, Corp., Foley, Fla., a 1949 graduate of the University of South Carolina.

Gad A. Rausing, Chief of Research and Development, Akerlund & Rausing A.B., Lund, Sweden, a 1952 graduate of Lund University.

Raul Rivera (Sandoval) Chemical Engineer, Cia. Industrial de Atenquique, S. A., Atenquique, Jalisco, Mexico, a 1951 graduate of the University of Mexico.

Charles H. Robson, Chief Engineer, Lanzit Corrugated Box Co., Chicago, Ill. Attended Armour Institute.

Masahiko Sannomiya, Chief of Beater Section, and Director of the Technical Div., Nihon Shigyo Kabushiki Kaisha, Ino-kyoku, Kochi-kan, Japan, a 1947 graduate of Kyoto Imperial University.

James A. Sargeant, Manager, Container Laboratories, Inc., Chicago, Ill. Attended the University of Cincinnati.

Clemmie N. Shirley, Librarian, U. S. Dept. of Agriculture Library, Madison Branch, Forest Products Laboratory, Madison, Wis. Attended the University of Denver and the University of Georgia.

William J. Simpson, Vice-President and General Manager, Crescent Box Corp., Philadelphia, Pa., a 1935 graduate of Pennsylvania State College.

Knud Somme, Superintendent, A/S Union, Skien, Norway. Attended the Norway Technical College and the Technical University, Darmstadt.

Roger A. Sullivan, Chief Chemist, Sullivan Paper Co., Inc., Springfield, Mass., a 1952 graduate of the University of Maine. (On leave of absence as 1st Lt., U. S. Army.)

Andre C. Toullet, Mill Manager, Regie Industrielle d Cellulose Coloniale, Paris, France, a graduate of the Nati School of Mines.

Harry K. Unonius, Manager, Machine Dept., Grubl A/B, Stockholm, Sweden, a 1932 graduate of the Techn University, Vienna.

John M. von Bergen, Manager, Airkem, Inc., New Y N. Y., a 1934 graduate of the University of Nebraska.

Takehiko Wada, Managing Director and Director of T nical Div., Nihon Shigyo Kabushiki Kaisha, Toyko, Japa 1921 graduate of Kyoto Imperial University.

Douglas M. Wallace, Student, New York State Colleg Forestry, Syracuse, N. Y.

John R. Ward, District Office Manager, Vapor Hea Corp., New York, N. Y. Attended the Illinois Institut Technology.

Eisi Yanagisawa, Manager, Nishima Paper Mill Co. L Harada Factory, Sizuoka-ken, Japan, a 1931 graduat Nagaoka Technical University.

TAPPI Notes

Charles S. Adams is now Sales Manager of Rice Ba Corp., Worcester, Mass.

Henry J. Adams is now President of The Salem Label Salem, Ohio.

Lawrence R. Adkins is now Chief Chemist for the Wa falls Tissue Corp., Mechanic Falls, Me.

Walter Ameen is now Mill Manager of Billeruds Saffle, Sweden.

Maurice S. Anderson is now Superintendent of Sulp and Groundwood Mill of the Oxford Paper Co., Rumf Me.

William V. Arnold, Jr., formerly of the Marathon Co is now Technical Director of Wausau Paper Mills Co., Brok Wis.

James R. Arthur is now Assistant Technical Director of Port Huron Sulphite and Paper Co., Port Huron, Mich.

Joseph E. Atchison is now Vice-President of Parson Whittemore, Inc., New York, N. Y.

Ralph Atkins, formerly of Potlatch Forests, Inc., is with the Gilbert Paper Co., Menasha, Wis.

Percy C. Austin is now Kraft Mill Consultant for Bathurst Power & Paper Co., Bathurst, N. B.

A. Walter Ayles, formerly of Penick & Ford Ltd., is Southern Sales Serviceman for Morningstar, Nicol, Jacksonville, Fla.

W. Garwood Bacon, Jr., is now Vice-President and S Manager of Industrial Yarns of E. W. Twitchell, Inc., Ph delphia, Pa.

Bruno H. Baldacci is now Assistant Superintendent Bemis Bro. Bag Co., Peoria, Ill.

Cecil H. Baldwin, formerly of the Marinette Paper Co now Technical Director of the Scott Paper Co., Ever Wash.

Orlando A. Battista is now Group Leader for Pulping search and Development for the American Viscose Co., M cus Hook, Pa.

Stanley A. Bazela, formerly of Doeskin Products, Inc now Project Engineer for the Scott Paper Co., Chester, P

H. L. Becher is now Chief Chemist for the Homosote Trenton, N. J.

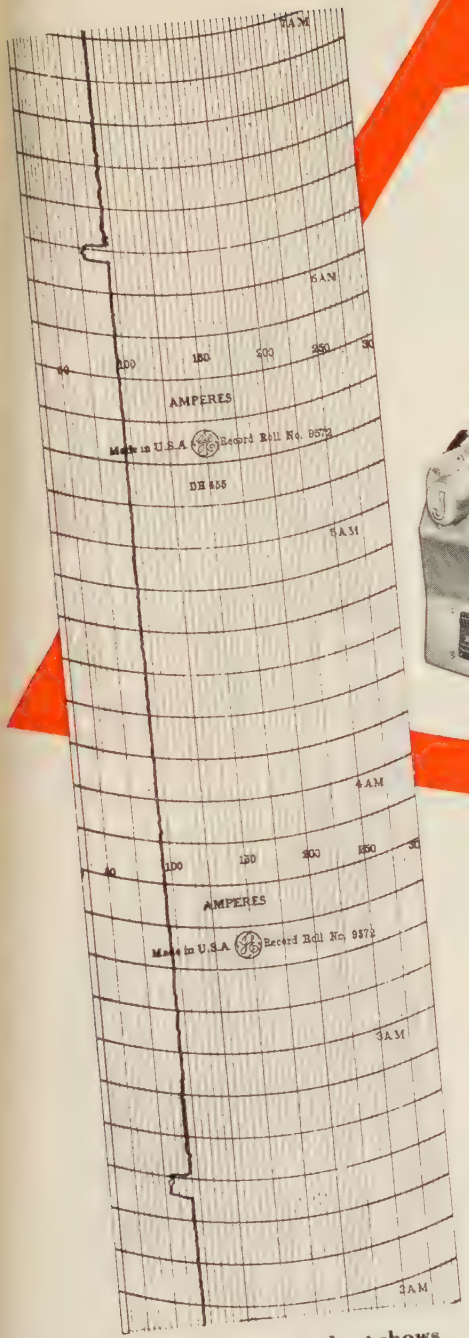
L. R. Benjamin is now General Superintendent of Australian Newsprint Mills, Ltd., Boyer, Tasmania.

William T. Bennett, formerly of the Halifax Paper Co now Assistant Mill Manager, Eagle Mill, Smith Paper D Peter J. Schweitzer, Inc., Lee, Mass.

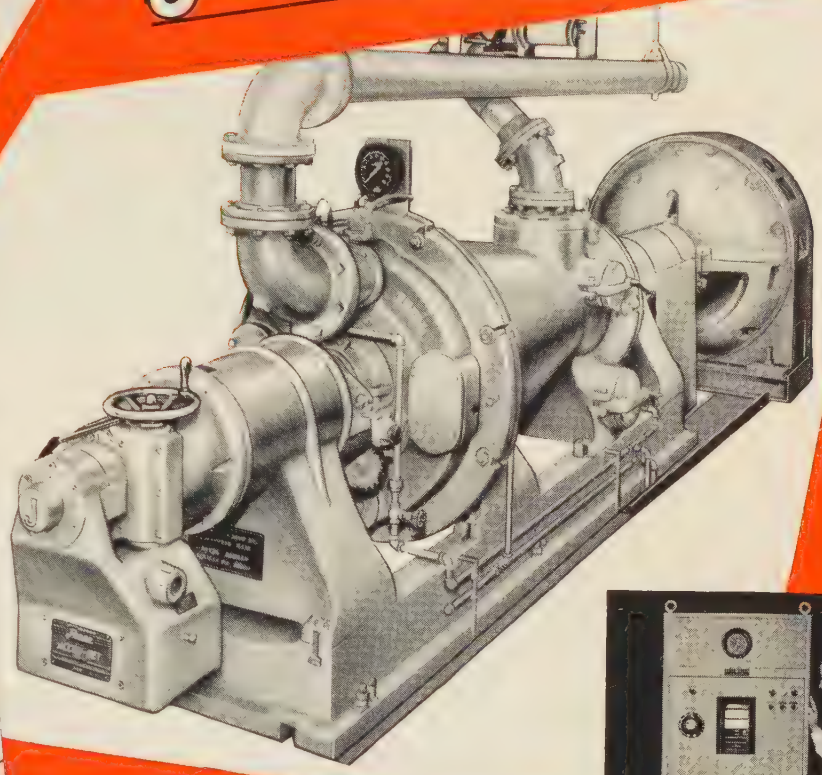
James M. Booth is now in Technical Sales for the Hu Milling Co., New York, N. Y.

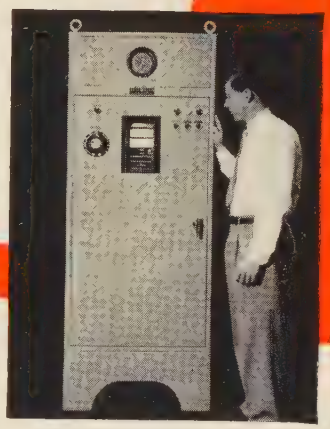
Clifton P. Boutelle is now General Superintendent of Paperboard Mill of Gardner Board & Carton Co., Lockla Ohio.

ANOTHER E.D. Jones INSTALLATION



This watt-meter chart shows uniformity of Jordan performance with Accru-Set Control.





Jones Royal Jordan (top) in Western Electric's Hawthorne Works, Chicago, has been operating under Accru-Set Control for a year. Inset shows typical control panel.

ACCRU-SET® Automatic Control makes this Jordan walk a chalk-line

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BUILDERS OF QUALITY STOCK PREPARATION MACHINERY

Edward F. Boyle is now Superintendent of the Federal Paper Board Co., Bogota, N. J.

Russell H. Bracewell is now Vice-President of Kupfer Bros. Co., Northbridge, Mass.

Earl M. Brennan, formerly of the Railway Supply & Mfg. Co., is now Technical Service Director of Alpha Cellulose Corp., Bloomington, Ind.

Bruce F. Brooks is now Production Manager of the Brown Paper Mill Co., Inc., Monroe, La.

Geoffrey Broughton is now Chairman of the Chemical Engineering Dept., University of Rochester, Rochester, N. Y.

Robert E. Brown, formerly of Rayonier, Inc., is now with Ketchikan Pulp Co., Bellingham, Wash.

George W. Brumley is now Vice-President and General Manager of St. Marys Kraft Co., St. Marys, Ga.

George F. Bryant has been transferred to the Multiwall Div., Union Bag & Paper Corp., New York, N. Y.

Karl E. Buff, formerly Consultant at Mountain Home, Ark., is now with the Ruberoid Co., Joliet, Ill.

John O. Burton is now Assistant Director of Research for the Minnesota & Ontario Paper Co., International Falls, Minn.

John Buss is now Assistant to the Manager of Provincial Paper Ltd., Toronto, Ont.

Ralph W. Buttery, formerly of Kraft Containers Ltd., is now in the Container Research and Development Dept. of Bathurst Power & Paper Co., Bathurst, N. B.

William H. Caddoo is now Vice-President in Charge of Boxboard Operations of Robert Gair Co., Inc., New York, N. Y.

James D. Cahill, Jr., is now President of J. D. Cahill Co., Haverhill, Mass.

A. J. Cameron is now Technical Service Manager for Canadian Industries Ltd., Montreal, P. Q.

Ragnar Carlgren is now Chief Chemist for W. F. Hall Printing Co., Chicago, Ill.

Anthony J. Cirrito, formerly of the Lukens Steel Co., is now Assistant to the President, Rice Barton Corp., Worcester, Mass.

Roger J. Clapp is now Advertising Manager of Linton Bros. & Co., Fitchburg, Mass.

T. K. Cleveland is now Vice-President of the Philadelphia Quartz Co. of California, Berkeley, Calif.

Harold H. Coffman is now Director of Research of Bareco Oil Co., Barnsdall, Okla.

Allan B. Copping is now Assistant Manager of the International Paper Co., Palmer, N. Y.

E. L. Crowley, formerly of Infilco, Inc., is now Field Sales Manager of the Carthage Machine Co., Carthage, N. Y.

Frederick S. Crysler is now Eastern Div. Manager (Boston, Philadelphia, Oaks, Pa., and Greensboro, N. C.) of the Container Corp. of America, Philadelphia, Pa.

Harry G. Davis is now Manager of the Maine Coated Div., Oxford Paper Co., Rumford, Me.

C. Delgado, Chemical Engineer of W. R. Grace & Co., has been transferred from Paramonga, Peru, to Lima, Peru.

H. A. (Gob) Des Marais, formerly of the Pennsylvania Salt Mfg. Co. of Washington, is now Manager of the Industrial Chemicals Div., Geigy Chemical Corp., New York, N. Y.

Frederick Dierks is now Vice-President of Dierks Lumber & Coal Co., Kansas City, Mo.

H. P. Dixson is now Vice-President in Charge of Manufacturing of the Fox River Paper Co., Appleton, Wis.

Clifford F. Dodge, Jr., is now Assistant to the President of A. J. Eckert Co., Inc., Albany, N. Y.

R. H. Doughty is now Technical Superintendent of Fitchburg Paper Co., Fitchburg, Mass.

Arthur C. Dreshfield is now Partner and Manager of the Chicago Testing Laboratory, Chicago, Ill.

J. R. Dufford is now Assistant General Manager of the Paterson Parchment Paper Co., Bristol, Pa.

Henry J. Driscoll is now Production Manager of Alfol sulating Div., Reflectal Corp., Hudson Falls, N. Y.

Albert G. Durgin is now Acting Mill Manager of the Lawrence Corp., East Angus, P. Q.

John K. Dyer, formerly of the Gaylord Container Corp. now Assistant Sulphate Pulp Mill Superintendent for Bowaters Southern Paper Corp., Calhoun, Tenn.

Arthur E. Erickson is now Technical Director of the Wey haeuser Timber Co., Pulp Div., Longview, Wash.

Alexander Euston is now Vice-President of the Byr Weston Co., Dalton, Mass.

John R. Fielding is now Construction Engineer for Union Bag & Paper Corp., Savannah, Ga.

Stanley A. Finlay is now Technical Supervisor of Alliance Paper Mills, Georgetown, Ont.

Thomas Foulkes is now Chief Engineer of E. B. Eddy C Hull, P. Q.

Jean Fournier is now President and Director General S/A Des Papeteries de Manderit, Quimperle, France.

Durward B. Geffken is now Assistant Superintendent of Oswego Falls Corp., Fulton, N. Y.

Theodore Geiger is now Librarian-Statistician of the Oxfo Paper Co., Rumford, Me.

Miss Germaine Gomez, formerly of the Champion Paper Fibre Co., is now Chemist for the Stream and Air Polluti Section, Harris County Health Unit, Pasadena, Tex.

Harry M. Gray is now Vice-President in Charge of Ope tions of the Oswego Falls Corp., Fulton, N. Y.

Russell C. Grimshaw is now Production Planning Assista for the Dixie Cup Co., Easton, Pa.

Gosta Hall is now Executive Vice-President of Korsnas A Gaffle, Sweden.

William J. Hall is now a Shift Foreman for the Wey haeuser Timber Co., Pulp Div., Everett, Wash.

Pralhad S. Hangal, formerly of the Oxford Paper Co., now located in Hubli, Bombay State, India.

Paul W. Hardesty is now Superintendent of Pulp Mills the Heald Div., Mead Corp., Lynchburg, Va.

Sam D. Hellberg is now Superintendent of Production of t Camp Mfg. Co., Franklin, Va.

Elliott G. Heslop is now Assistant Mill Manager of t Abitibi Power & Paper Co., Sturgeon Falls, Ont.

Charles F. Hill, Jr., is now Assistant Technical Director the Sorg Paper Co., Middletown, Ohio.

Edward R. Hoffman, formerly of the Hammermill Pap Co., is now Chief Statistician of the Oxford Paper Co., Ru ford, Me.

Ray N. Hollands is now Quality Control Manager of t Marathon Corp., Menasha, Wis.

L. Randall Hollinger is now General Superintendent of t Stone-Mann Paper Co., Mobile, Ala.

Igmar Jaatinen is now Managing Director of Osakeyh Toppila, Oulu, Finland.

Edwin C. Jahn is now Associate Dean for Physical Scien and Research of the College of Forestry, State University New York, Syracuse, N. Y.

George W. Knapp is now Manager of Engineering Practi Industrial Engineering Section, General Electric Co., Schen tady, N. Y.

David J. Kraske, formerly Student at Western Michig College, is now a Technical Service Engineer for the Oxfo Paper Co., Rumford, Me.

Robert M. Kuhn, formerly of the U. S. Chemical Warfa Service, is now Sales Engineer for the Rees Blow Pipe C San Francisco, Calif.

E. L. Lamb is now Production Assistant to the Executi Vice-President of Minnesota & Ontario Paper Co., Minn apolis, Minn.

Gerald Larocque of the New York *Daily News* has been elect to the Board of Directors of the St. Croix Paper C Woodland, Me.

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Picture of "Vanceometer" Oil Absorption Tester courtesy of Hillside Laboratory, Hillside, Ill.

Horace N. Lee, formerly of the Fabric Research Laboratories, Inc., is now an Instructor and Consulting Microscopist in the Paper Engineering Dept., Lowell Technological Institute, Lowell, Mass.

Richard Lindenfelser is now Group Leader for the American Cyanamid Co. Research Laboratories, Stamford, Conn.

John O. Logan is now Executive Vice-President of the Industrial Chemical Div., Mathieson Chemical Corp., Baltimore, Md.

Richard R. Lowell is now Technical Director of Louis De Jonge Co., Fitchburg, Mass.

Nils B. Lundgren is now Mill Manager of Halmen Bruksock Fabriks A/B., Norrkoping, Sweden.

Melvin H. Lustbader is now Chief Chemist of Autographic Business Forms, Inc., Hoboken, N. J.

Murray MacNaughton, formerly of Howard Smith Paper Mill Ltd., is now Research Chemist for Alex Cowan & Sons Ltd., Valleyfield Mills, Penicuik, Midlothian, Scotland.

Harold O. McInerney is now Mill Manager of Price Bros. & Co. Ltd., Kenogami, P. Q.

Wm. H. McPherson is now Manager of the Research Laboratory, Minnesota & Ontario Paper Co., International Falls, Minn.

Bruce W. Martin is now Division Manager of the American Boxboard Co., Filer, Mich.

Jack E. Meadows is now Assistant Production Manager of the Crossett Paper Mills, Crossett, Ark.

Arthur C. Megalos, formerly of the Constellation Cup Corp., is now Production Supervisor of Federal Adhesives Co. Brooklyn, N. Y.

Walter S. Miller of the Gulf Oil Co. has been transferred from Pittsburgh, Pa., to Boston, Mass.

John S. Moore is now Group Leader in the Mill Technical Dept. of the Union Bag & Paper Corp., Savannah, Ga.

L. A. Moss is now Mill Manager of the Whiting-Plover Paper Co., Stevens Point, Wis.

William A. Mueller is now Head of Cellulose Research for the Buckeye Cotton Oil Co., Memphis, Tenn.

A. G. Natwick is now Resident Manager of the East Texas Pulp & Paper Co., Silsbee, Tex.

Ralph K. Nelson is now Superintendent of the Nu-Wood Dept., Wood Conversion Co. Cloquet, Minn.

Edward K. Nissen, formerly of the Nekoosa-Edwards Paper Co., is now Technical Service Representative for the Solvay Process Div., Allied Chemical & Dye Corp., Syracuse, N. Y.

John F. Nolan is now Superintendent of the Ogelsby Mill, Sorg Paper Co., Middletown, Ohio.

Hugh C. Osborn, formerly of the R. T. Vanderbilt Co., is now Technical Representative of the General Dyestuff Corp., Portland, Ore.

Merrill J. Osborne is now Electrical Superintendent of the Bowaters Southern Paper Corp., Calhoun, Tenn.

Takeo Ota is now President of the Nippon Pulp Industry Co., Ltd., Tokyo, Japan.

R. Paradis is now Assistant to the Resident Manager, Ontario-Minnesota Pulp & Paper Co., Kenora, Ont.

Philip H. Prior is now Deputy Chief of the Technical Div. of Aylesford Paper Mills, of Albert E. Reed & Co., Larkfield, Kent, England.

Alejandro Puron, formerly of Fabrica de Papel Coyoacan, is now General Manager of Gabrica de Celulosa "El Pilar" S/A, Ayotla, Edo, Mexico.

John W. Ramsey is now General Superintendent of the Champion Paper & Fibre Co., Hamilton, Ohio.

Roger E. St. Pierre is now Process Control Superintendent of the Brown Co., Berlin, N. H.

John W. Pontius is now in the Technical Advisory Section, Champion Paper & Fiber Co., Hamilton, Ohio.

Thomas E. Price is now Technical Service and Salesman for C. P. Hall Co., Chicago, Ill.

T. Richard Probst is now Assistant General Manager of the Oregon Pulp & Paper Co., Portland, Ore.

Edward J. Romatowski is now Technical Service Supervi for the Barrett Div., Allied Chemical & Dye Corp., Tole Ohio.

L. S. Sabatke is now General Paper Mill Superintendent the Marathon Corp., Rothschild, Wis.

Erwin Schmidt is now Vice-President of Zellstofffab Waldoof, Wiesbaden, Germany.

Ryo Shinoda is now Managing Director of Tomoega Paper Mfg. Co., Ltd., Shizuoka, Japan.

G. Robert Sido is now Production Supervisor of the M santo Chemical Co., Port Plastics, Ohio.

George C. Sisler is now Control Engineer of the Abit Power & Paper Co., Sault Ste. Marie, Ont.

Allan G. Strang is now Technical Director and Parchm Superintendent of the Columbia River Paper Mills, V couver, Wash.

Gordon Sutton is now Mill Manager of the Abitibi Pov & Paper Co., Port Arthur, Ont.

Gabriel T. Turula, Chemist for the Corn Products Refin Co., has been transferred from New York City to Argo, Ill

Mrs. Miriam S. Vincent, President of George Vincent, Ir has moved her office from New York City to 95 Industr Ave., Allwood, N. J.

A. Dale Wolvin, formerly of the Empire Box Co., is n with the Eddy Paper Corp., Div. of Kieckhefer Contai Co., Chicago, Ill.

Alan J. Woodfield is now Vice-President of the Continen Paper Co., Ridgefield Park, N. J.

* * *

Leslie P. Peck, Assistant Superintendent, has succeed *Harrison Kindred* as the official corporate representative the Mac Sim Bar Paper Co., Otsego, Mich., in TAPPI.

The Hudson Pulp & Paper Co. has moved its main offi from 505 Park Ave. to 477 Madison Ave., New York 22, N.

* * *

James F. Kurtz has succeeded *Thomas J. Neel* as the offi representative of the Keever Starch Co., Columbus, Ohio. the Technical Association.

Burnett Q. Haynes, Manager of the Mullen Tester D has succeeded *John L. Perkins III* as the official represen tive of B. F. Perkins & Son, Inc., Holyoke, Mass.

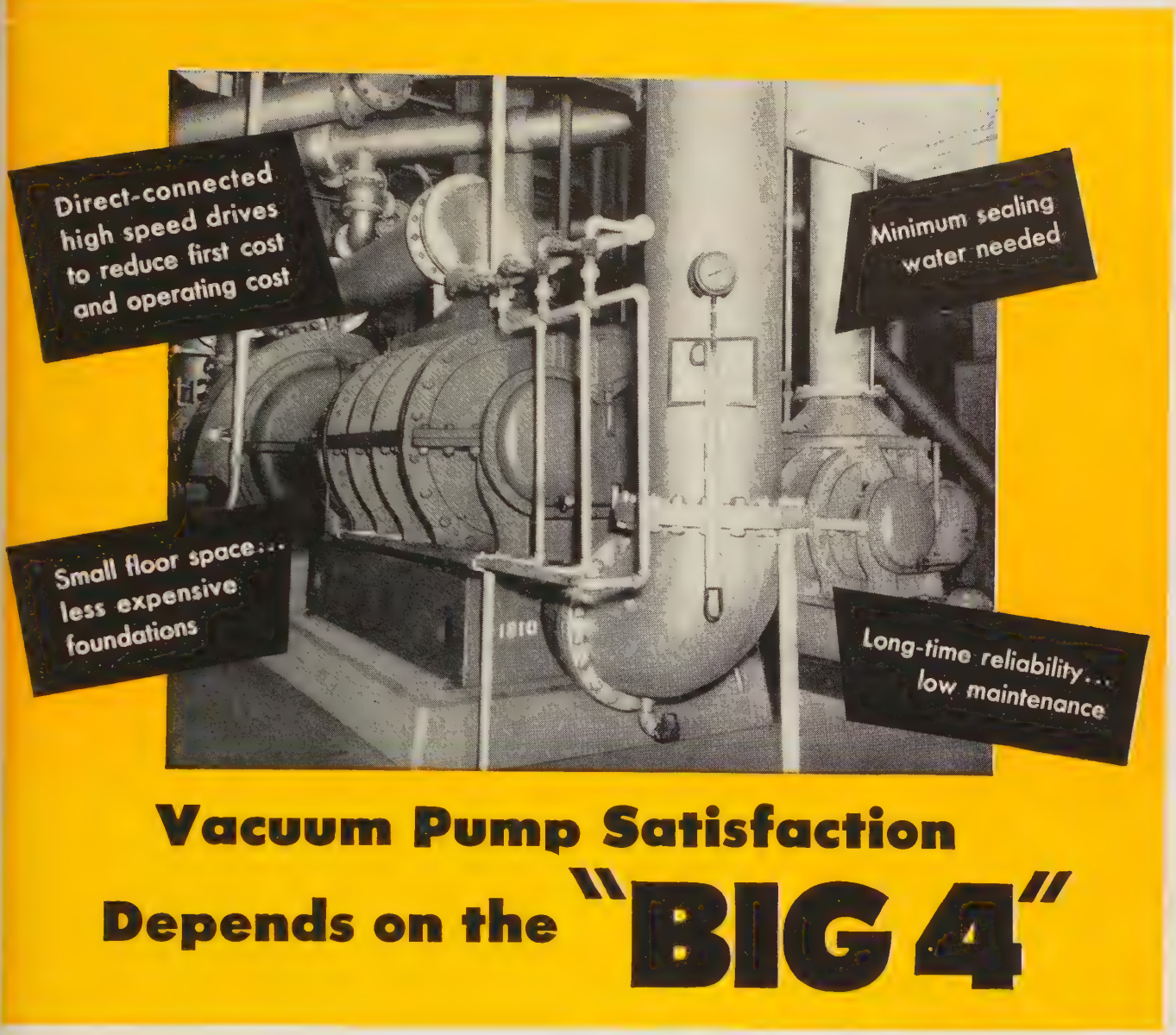
American Key Products, Inc. has moved its New Yo office from 270 Madison Ave. to 12 E. 42nd St.

Industry Notes

PRODUCTION

In February the production of paper and paperboard estimated to have been 2,033,000 tons. This was 45,000 le than in February, 1953, and 65,000 less than in Februa 1951, but did represent the third best February on recor Although production for the first two months of this yea 4,195,000 tons, was approximately 2% less than for the sa period in 1953, it is noteworthy that the output of paper, distinguished from paperboard, slightly exceeded that of la year and that the over-all drop was chiefly due to a decrea of about 5% in the manufacture of paperboard. This situ tion has, of course, been reflected in the operating ratios the two segments which have been about 94% for paper a 89% for paperboard.

By maintaining output at a high level the paper indust continued to resist the general decline which has affected t majority of industries. Further evidence of this compar tive strength is found in the Federal Reserve Board Produ tion Indexes for January. Using the series which is una justed for seasonal variation, this report shows that the produ tion index for paper and paperboard was 122 in Januar 1954, as opposed to 121 for the same month of 1953; for pape


Direct-connected high speed drives to reduce first cost and operating cost
Minimum sealing water needed
Small floor space... less expensive foundations
Long-time reliability... low maintenance

Vacuum Pump Satisfaction Depends on the "BIG 4"

More and more paper mills are realizing the value of these "Big 4" essentials that are built into every Roots-Connersville Vacuum Pump.

They have proved by experience that R-C equipment reduces first cost by requiring smaller motors and less expensive foundations, because of higher speed operation, at 600 rpm or more. They see lower operation cost because of less power and water consumption. Most important of all, they have found that the dependability of R-C Pumps brings almost complete freedom from down time and lost production.

Single or compound units, in wide capacity ranges to meet your specific requirements, still further reduce your burden and your operating expense.

We suggest that you ask R-C engineers to look over your present pumps, or your plans for new equipment, to see how you can produce more tons of paper at less cost. For basic information, ask for Bulletin 50-B-13.

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board only, the comparable figures were 128 and 130, indicating that the production of paper in January had been sufficiently high to more than offset the slight decrease in the output of paperboard. By way of contrast, the indices for total manufactures were 125 and 135; for durable manufactures 140 and 154; and for nondurable manufactures 111 and 115. Of the twenty major industry groups included in this index, fifteen show decreases, four increases, and one (Paper and Allied Products) remained unchanged. How long this condition will persist is, of course, open to question, for unless general business activity soon levels off and rebounds, this industry too will probably experience a greater decrease in production. Nevertheless, the present situation demonstrates again the relative stability of the paper industry and is illustrative of the fact that it is somewhat less susceptible than most industries to effects of a decline in business activity.

Pulpwood

Pulpwood receipts for January totaled 2,394,000 cords—2,257,000 cords of domestic pulpwood and 137,000 cords imported. January receipts this year were 37,000 cords under receipts for January, 1953.

Consumption of pulpwood continued at a high level in January—2,386,000 cords, an increase of 219,000 cords over the previous months, December, and an increase of 19,000 cords over consumption in January of last year.

Inventories at the end of January were 5,639,000 cords, a decline of 11,000 cords from December and 368,000 cords under inventories at the end of January, 1953.

Wood Pulp

Wood pulp production in January was 1,491,000 tons, based on preliminary census data; an increase of 154,000 tons over December and an increase of 20,000 tons over January, 1953.

Consumption of wood pulp was 1,549,000 tons in January, increasing 117,000 tons over December, but was 13,000 tons below consumption in January, 1953.

Imports of wood pulp in January showed a considerable drop both in comparison to December and January, 1953. Imports were 144,406 tons, a decline of 32,758 tons under December, and a decline of 45,515 tons under January of last year.

Exports of wood pulp in January were 13,000 tons, equalling exports in January, 1953.

Inventories of wood pulp at the end of January were 641,000 tons, a decline of 16,000 tons under December and a decline of 57,000 tons under January, 1953. Inventories at the end of January this year were 150,000 tons at pulp mills and 491,000 tons at paper and board mills.

Newsprint

Production and shipments of newsprint in North America during March, 1954, amounted to 613,597 tons—an all-time monthly high—and to 582,072 tons, respectively, compared with corresponding totals of 576,187 tons and 536,017 tons in March, 1953. Output in the United States was 98,115 tons and shipments were 100,585 tons while Canadian (including Newfoundland) production amounted to 515,482 tons—the peak monthly record to date—and shipments totaled 481,487 tons.

Through the end of March this year United States mills turned out 14,004 tons or 5.2% more newsprint than in first three months of 1953 while output in Canada also 52,477 tons or 3.8% greater than in the corresponding pe of last year, thus the continental increase totaled 66, tons or 4.0%.

North American manufacturers' stocks on March 31, 1 aggregated 197,753 tons compared with 166,228 tons on last day of the preceding month and 210,543 tons at the of March, 1953. The continental total was composed of 8 tons and 189,067 tons held by the United States and Ca dian mills, respectively, and inventories were lower tha year ago by 11 tons in the former instance and by 12,779 t in the latter.

Newspaper Cost

Two cents will still buy a daily newspaper in two Penn vania cities, but the trend toward higher daily paper r continues across the country, according to a survey by American Newspaper Publishers' Association.

According to the New York *Herald-Tribune*, April 1954, the survey shows that 6-, 7-, and 10-cent newspa have increased to 208 from 168 a year ago. There w sixty-eight newspapers selling at those prices in 1952 a twenty-nine in 1951. The nickel papers are decreasing, ANPA reports. There now are 1461 compared with 1 a year ago, 1583 in 1952 and 1594 in 1951. There now twenty-two newspapers selling for 3 cents, eleven less t a year ago.

Paper Bags

Production of bag paper in 1953 was 9.7% above the 1 volume. The 882,593 tons produced during the year est lished a new record with the total 4.4% above the previ record of 1951. Similarly, the fourth quarter volume v 21.0% above the comparable period of 1952. For the sa periods, the output of unbleached kraft bag paper increa 21.3%. Bag paper output in the fourth quarter was 13. above the 214,191 tons of the previous quarter. The to tonnage produced in the final quarter of 1953 was gre than any quarter in post-World War II years.

Demand for paper bags in the fourth quarter was stead lower as seasonal business ended during the period. Oct operations were slightly below September although a pick occurred in November. December was seasonally sl Compared with the fourth quarter of 1952, however, busin was improved. Bag prices were firm although a few scatte concessions occurred. Raw materials were readily availa at steady costs. Demand in January was strong as indus views the first quarter 1954 business satisfactorily.

Setup Paper Boxes

Fourth quarter production of setup boxboard decrea progressively through October, November, and Decem with the total 9.2% below the final period in 1952. Similar production was 6.5% below the third quarter 1953 volume 189,983 tons. Production for 1953 established a new rec for the industry as a 9.8% gain was registered over the 1 volume. The 1953 output was 3.0% above the previ record of 733,475 tons of 1951.

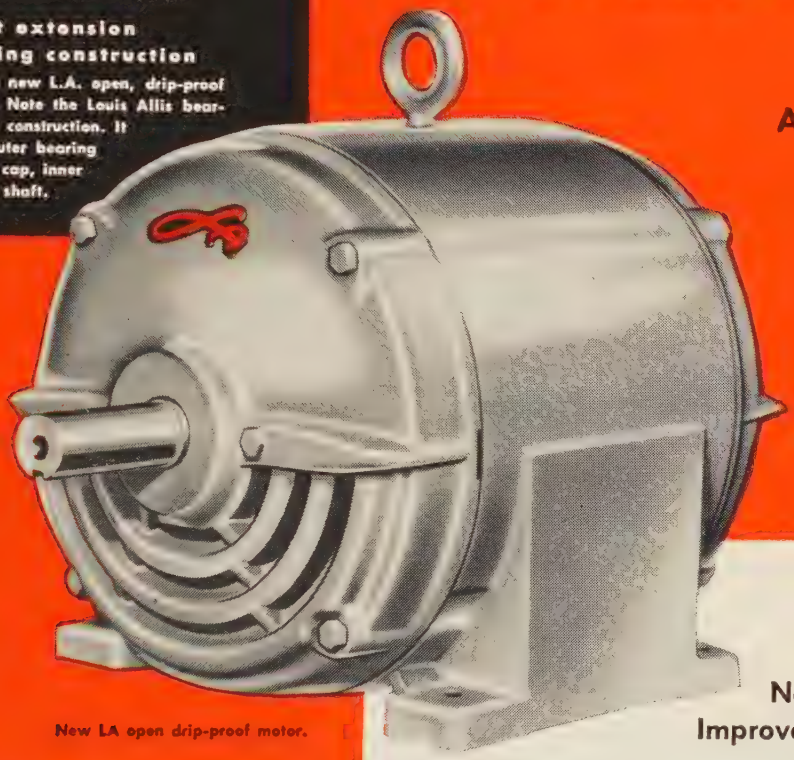
Demand for setup paper boxes continued strong into t third quarter as seasonal requirements were heavy. Octo

Fourth Quarter and Yearly Production of Bag Paper, 1953–52 (Short Tons)

	1953		1952		Percentage change	
	4th quarter	*Year*	*4th quarter*	*Year*	*4th quarter*	*Year*
Bag paper, kraft, unbleached	226,040	817,637	186,341	748,929	+21.3	+9.2
Bag, glassine, greaseproof and vegetable parchment	4,010	14,070	3,281	55,463	+22.2	+17.3
Other wrapping paper	13,256	50,986	11,473		+15.5	
Bag paper, total	243,306	882,693	201,095	804,392	+21.0	+9.7

Here's another reason why the NEW L.A. *Line by the Louis Allis Co. is your* BEST *electric motor* BUY

Shaft extension bearing construction used in new L.A. open, drip-proof motors. Note the Louis Allis bearing-cap construction. It locks outer bearing race to cap, inner race to shaft.



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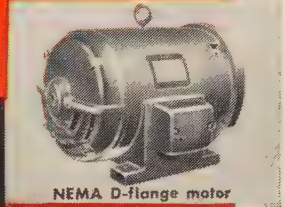
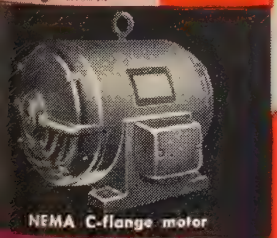
Vertical NEMA C-flange motor



NEMA D-flange motor



NEMA C-flange motor

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LA-105

Fourth Quarter and Yearly Production of Setup Boxboard, 1953–52 (Short Tons)

	1953	1952	Percentage change
October	66,942	72,326	− 7.4
November	59,540	65,608	− 9.2
December	51,181	57,630	−11.2
Fourth quarter total	177,663	195,564	− 9.2
Yearly total	755,265	687,599	+ 9.8

Source: Bureau of the Census.

and November operations were at near capacity with some plants working overtime to meet demands. By the middle of December, however, business was slower as holiday demands were filled. Order backlogs were worked down by December and overtime operations were eliminated. Deliveries were extended slightly during the quarter although they were met on schedule. Container prices were steady as were raw material costs. Inventories of raw materials were normal although finished containers were up by the end of the year. Several box makers granted wage increases during the fourth quarter. The outlook for the industry is optimistic as most manufacturers foresee 1954 business at or slightly below the record 1953 level.

Fiber Can and Tubes

The total 1953 dollar sales of the fiber can and tube industry is estimated at $155,000,000 which represents an estimated 18% increase over the previous year. Of the total, approximately $60,000,000 was for ammunition containers. Civilian use of fiber cans and tubes in 1953 increased about 12% over the 1952 level. The totals of 1953 annual output and sales established new records for the industry.

For 1953, sales increased 24.0% for fiber cans, 15.8% for spiral tubes and cans, and 8.2% for miscellaneous specialties. The sale of convolute tubes, however, dropped 1.8% below the 1952 volume.

Despite labor difficulties in several plants, fourth quarter sales of all products were 2.3% above the fourth quarter 1952 volume. Production of civilian items in the last quarter was about 4% above the comparable period of 1952. Fourth quarter can sales increased 12.5% whereas all other types dropped; spiral tubes and cans were down 6.1%, convolute tubes declined 21.0%, and miscellaneous specialties sales were 11.6% lower than in the fourth quarter of 1952.

Sales tapered off in the fourth quarter from the third quarter 1953 level with a work stoppage in December closing several plants. The total of all products was down 4.3% with all categories lower. Sales were off 2.1% for cans, 5.9% for special tubes and cans, 13.4% for convolute tubes, and 7.7% for miscellaneous specialties.

Customers' forward buying in the fourth quarter was slower than in the previous period. Order backlogs were lower. Users inventories were also down from the third quarter. Raw materials were ample at steady prices. Container prices were also firm. For 1954, the stretch-out of Government ammunition container requirements is expected to reduce substantially the output of those items from the 1953 volume. Despite this, increased civilian uses are expected to keep 1954 demand at a satisfactory level.

Paper Milk Containers

Production of paper milk containers in 1953 increased about 8% over the 1952 total despite the December work stoppage in several plants. Total output for 1953 is estimated at 9,712,151,000 containers. Fourth quarter operations were approximately equal the third quarter volume. October and November production was heavy in those plants closed in December whereas a change-over in container design limited output in other plants. Compared with fourth quarter 1952 level of business, total production was approximately 5% heavier although gains and losses varied widely betw plants.

Raw materials were in ample supply at firm costs. C tainer prices were steady to slightly lower as reduced oper ing costs in many plants were passed along to consume Operations in January were heavier than in the preced period with indications that the first quarter will exceed 5 to 15% the first quarter 1953 volume.

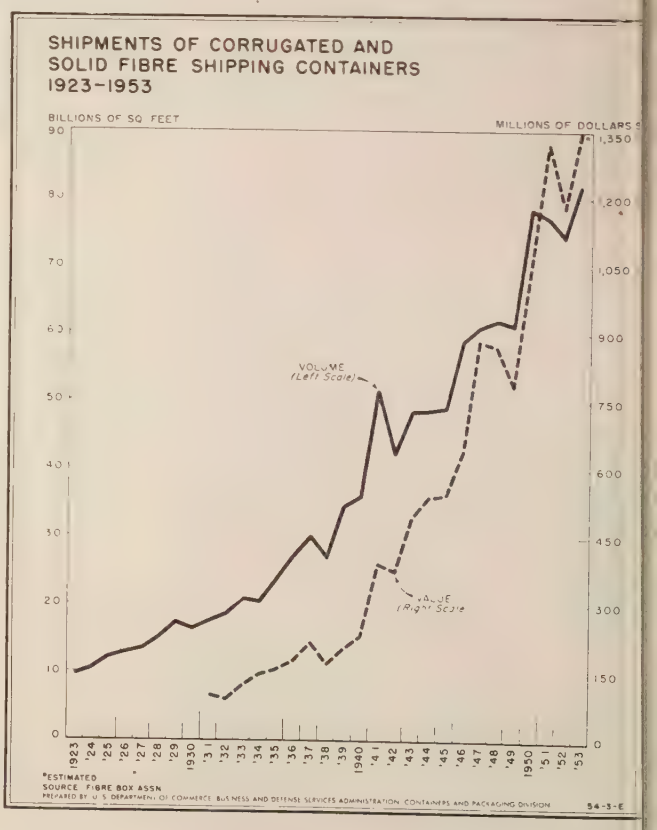
Paper Shipping Sacks

Production of shipping sack paper in 1953 increased 3.9 over the total of the previous year. The production 782,692 tons in 1953 was the second highest year on rec and only 7.8% below the 1951 record output. Fourth quar production continued strong with a 12.8% gain registe over the comparable period 1952 with December outp increasing 20.8%. Output of the fourth quarter was a 8.3% above the 186,915 tons of the preceding period.

For the year, approximately 2¼ billion multiwall ba were shipped. Demand for paper shipping sacks continu strong through the fourth quarter despite a slight increase price. Operations tapered off in December as most seaso requirements were filled. Bag paper was in plentiful supp and inventories were normal. Manufacturers expect fi quarter business to equal or exceed the comparable period 1953 as January operations increased substantially in so regions. The industry is optimistic over 1954 busin potentials.

Corrugated and Solid Fiber Shipping Containers

Production of container board in 1953 exceeded by 6.6 the previous record output of 6,322,782 tons of 1951. Outp of liners increased 7.8%, corrugating materials increased 5.0 and chipboard increased 0.1%. Container board output 1953 was also 16.9% above the 1952 volume. Liners, co rugating material, and chipboard output increased 16.4, 18 and 15.8%, respectively. Fourth quarter production liners increased 3.6% over the same period of 1952 as did co rugating materials by 6.7% and chipboard by 1.6%. To production of container board was 4.3% above the fou quarter 1952 volume. Compared with the third quarte


SHIPMENTS OF CORRUGATED AND SOLID FIBRE SHIPPING CONTAINERS 1923–1953
BILLIONS OF SQ. FEET
MILLIONS OF DOLLARS
VOLUME (Left Scale)
VALUE (Right Scale)
*ESTIMATED
SOURCE: FIBRE BOX ASSN.
PREPARED BY U. S. DEPARTMENT OF COMMERCE, BUSINESS AND DEFENSE SERVICES ADMINISTRATION, CONTAINERS AND PACKAGING DIVISION
54-3-E

Exclusive **Nose Baffle**

Keeps B&W Recovery Units

ON THE LINE LONGER

Forced outages and down time are expensive in terms of both lost production and costs involved in getting recovery units back on the line. Keeping those costly, non-productive periods few and far between,—to clean and remove smelt deposits—is the job of the NOSE BAFFLE found *exclusively* in B&W Recovery Units.

PROBLEM:—How to shield the ash deposits on the superheater from the radiant heat of the furnace, and direct the flow of high-temperature gas from the furnace so that all of the gas is cooled to the same degree before entering the superheater. The function of the Nose Baffle is to solve this problem.

RESULT:—Through the use of the B&W Nose Baffle, ash deposits in zone where superheater tubes are closely spaced are soft, powdery and easily removed. The B&W Nose Baffle cuts frequent, difficult cleaning to the minimum and completely eliminates cleaning outages. Lower operating cost may be realized from lower temperatures, improved cleaning and continuous operation. The B&W Unit stays on the line longer.

And high availability is one of the many benefits of a B&W Recovery Unit. For nearly 20 years B&W Recovery Units have demonstrated economical operation and high availability in leading pulp and paper mills. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX

BOILER DIVISION

P-786

1953, total production of container board was about the same with a 0.7% decrease registered. For the same period, liners and chipboard were 1.0 and 7.1% lower, respectively, whereas corrugating material increased 1.2%.

For 1953, box plants consumed 8.9% more board than in 1952. Similarly, board consumption exceeded the previous record of 1950 by 5.0%. The industry shipped 82.1 billions sq. ft. of board which surpassed by 4.7% the 1950 record shipments of 78.4 billions sq. ft. and the 1952 volume of 74.4 billions sq. ft. by 10.3%.

Consumption of board in the fourth quarter was below both the preceding period and the fourth quarter of 1952. Box plants use of liner, corrugating material, and chipboard dropped 4.9% from the fourth quarter of 1952, and 5.4% from the third quarter of 1953.

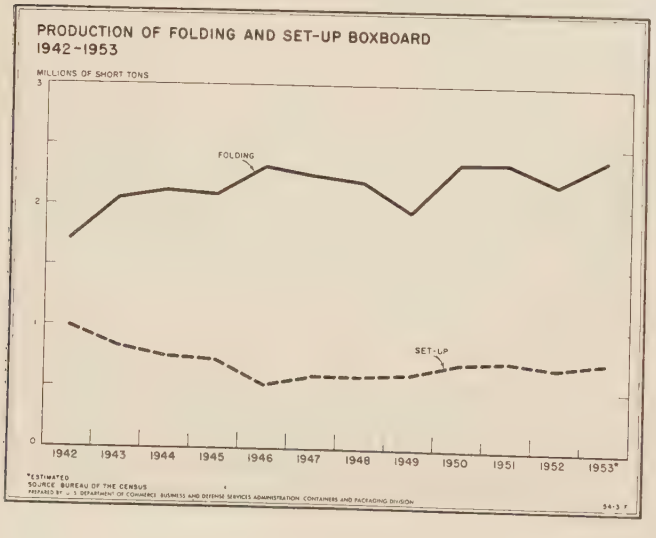
Demand for boxes was heavy through October and into November with a downturn in business occurring late in November. Seasonal business was largely completed by that time and order backlogs were worked down. Raw material inventories were heavier near the end quarter than in the previous quarter or the final quarter of 1952. Box prices were unchanged as were raw material costs. Customer inventories were down and buying for immediate delivery increased. Box orders were slow at the outset of 1954 although a pickup occurred toward the end of January. For January, box plants consumed 7.9% less container board than in January, 1953; similarly, board production was off 6.1%. Manufacturers view first quarter 1954 business at 5 to 10% below the initial quarter of 1953. Business in the second quarter is expected to improve and hold through the third quarter and most of the fourth with the yearly volume approaching the 1953 total.

Folding Paper Boxes

Production of folding boxboard in 1953 set a new record for the industry as the output of 2,427,396 tons exceeded the 1952 total by 10.7% and the record year of 1951 by 65,040 tons or 2.8%. Fourth quarter board production was 0.8% below the comparable period of 1952. October and November output was below the comparable months of 1952 whereas December was 2.5% above. Operations in the fourth quarter were approximately equal the third as production was down 0.5%.

For the year, the tonnage of folding paper boxes shipped was 9.8% above the 1952 volume; dollarwise shipments increased 8.8%. Orders entered were similarly above the 1952 totals with the dollar volume up 7.6% and the tonnage up 6.5%.

Fourth quarter 1953 shipments of folding paper boxes were heavier both in dollar volume and tonnage than in the same period of 1952. Dollar-wise shipments increased 5.8%; tonnage-wise shipments increased 4.0%. The dollar volume or



orders entered was also above the fourth quarter 1952 to by 1.7% whereas the total tonnage was down 1.4%.

For October, shipments increased 4.3% in dollar volu and 0.8% in tonnage compared with October, 1952 tota For the same month the dollar volume and tonnage of ord entered declined 1.4 and 4.1%, respectively. The dol volume of orders entered and shipments billed in Novemb increased over November, 1952, by 0.8 and 8.3%, in th order. The tonnage of orders entered dropped 3.3% fr November of 1952 whereas shipments increased 6.6%. December, the dollar value and tonnage of shipments a orders entered increased over December, 1952. Dol volume and tonnage of orders entered increased 5.7 and 3.2 respectively, whereas shipments billed increased 4.8% dollar value and 4.5% in tonnage.

Although orders entered during the fourth quarter we below the preceding period, shipments were heavier. T dollar volume of orders dropped 4.3% whereas shipments i creased 2.8%. Similarly, the total tonnage of orders e tered was 5.1% below the third quarter volume where shipments in tons improved 0.2%.

Active demand of the third quarter carried over into t final quarter; October output was particularly heavy to co plete seasonal business. During this period, several plan operated on an overtime basis. This overtime work w not, however, general for the industry and ended by t middle of November. Raw materials were plentiful wi board prices unchanged. Order backlogs were down seaso ally. Box prices were generally steady for the industry a though off slightly in some regions. Orders entered f January were below January, 1953, in both dollar volu and tonnage; dollar volume by 6.2% and tonnage by 7.7 Shipments for January were similarly lower than in 19 with the tonnage volume off 4.8% and the dollar volume 2.8%. Manufacturers view operations for the first half 1954 as satisfactory with business expected to be appro mately 5% lower than in the same period of 1953.

Wastepaper

With all grades of wastepaper in plentiful supply, the was little change in the first quarter of this year from that the first 13 weeks of 1953.

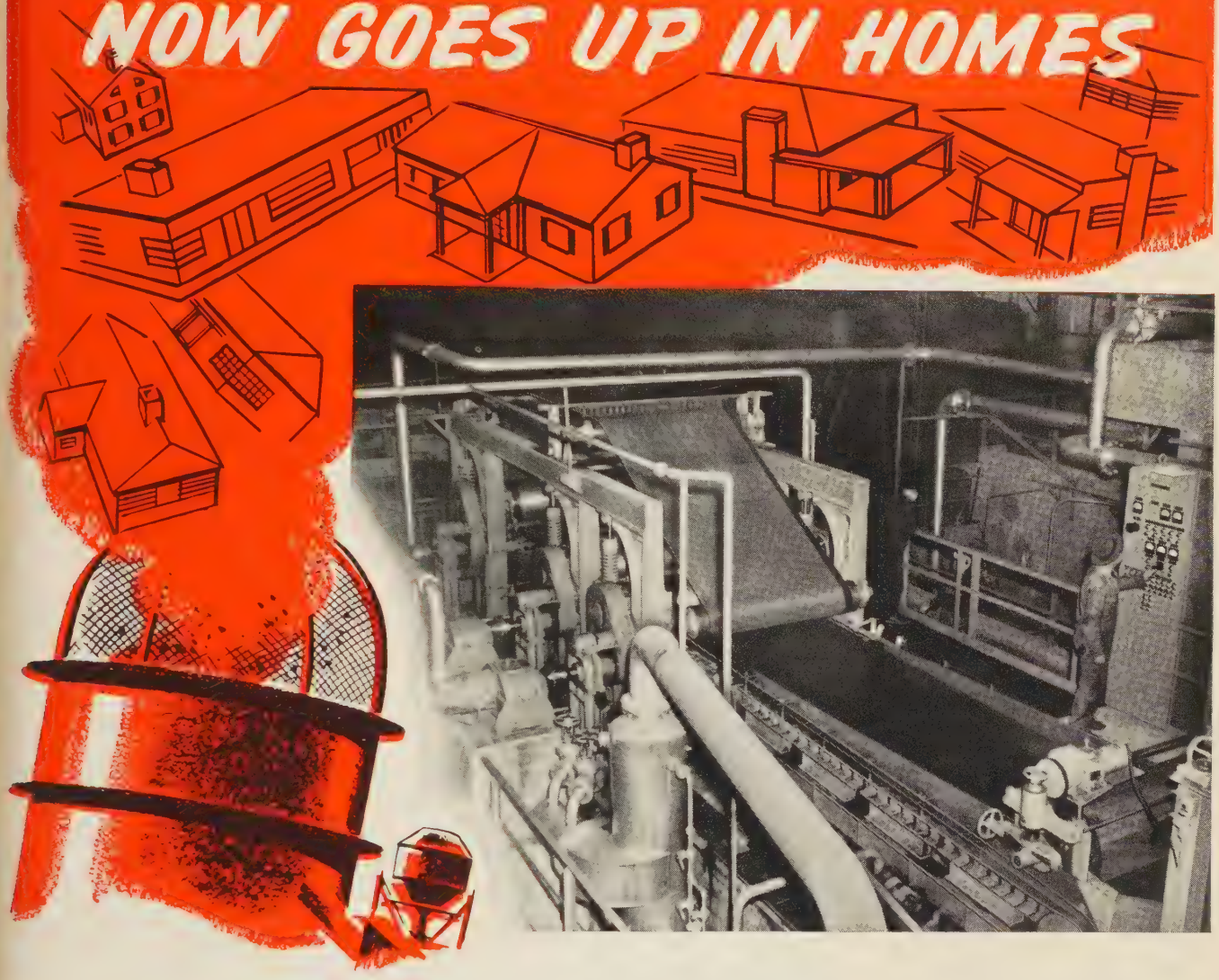
In January, the Eastern mills purchased only 94% of the paperstock requirements, but during February and Marc bought substantially more than their full requirements f those months. In the first three weeks of April, averag weekly purchases of wastepaper dropped 5% below the ave age weekly purchases in March. Average weekly purchas of the mixed grades dropped 9.9%, new grades 3.2%, old co rugated 3.1%, and high grades 2.6% from the March ave ages. Average weekly consumption of the mixed grades fe 8%, news 1.7%, corrugated 3.4%, and high grades 0.2% fro March.

In the last eight years prior to 1954 the average week purchases of paperstock by the eastern mills increased mont by month from the beginning of the year until the month May. This year the drop came a month earlier.

For the first time this year, in the week ending April 2 total purchases of wastepaper by the eastern mills droppe behind last year's purchases for the year's first 16 weeks, an while only four-tenths of 1%, it does indicate a change of pac in the buying programs of the eastern consumers.

Container grades of wastepaper—chiefly old corrugate boxes—lead all other grades in demand by the wastepape consuming industries, according to a survey just completed According to our estimates—and they can only be estimates— a greater tonnage of the container grades was purchased an consumed last year than any of the other wastepaper classif cations. Of the total consumption of 8,530,000 tons of waste paper in the United States last year, our survey indicate

WHAT WENT UP IN SMOKE NOW GOES UP IN HOMES



DOWNINGTOWN HARDBOARD MACHINES HELP CONVERT LUMBER BY-PRODUCTS INTO PROFITABLE BUILDING MATERIAL

Downingtown Fourdrinier-Type Hardboard Forming Machines and Press Sections are playing an increasingly important role in a great new industry. Bark, slabs, chips and other lumber manufacturing by-products, which were once burned, are now being successfully and economically converted into hardboard for American homes. Pulp mills also use Downingtown Hardboard Machines to manufacture hardboards from available stands of hardwood, undesirable for pulp.

Downingtown Hardboard Machines are now operating in several important lumber producing areas and quickly repaying their costs in the profitable utilization of what was once "waste" material. Similar Downingtown machines are built to produce insulation and wallboards of all types.

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MODERNIZATION IS PROFITABLE

that 29% was of the container grades, 26% of the high grades, 23% of the mixed grades, and 22% of the news grades.

. . . *What is the major export of Washington, D. C.?* Wastepaper! About 1,000,000 tons of wastepaper valued at $2,000,000 leave the city each year by truck or rail. More freight cars are needed to ship wastepaper than for any other single item. Thus, even the letters you write to your Congressman are not wasted.

Poland

Poland's new newsprint mill at Skolwin started up in February of this year. An additional machine, 6 yards wide, is to be installed, and Eastern Germany is to supply additional machinery to enable the plant to turn out better quality papers as well.

Still further enlargements are to be made to the factory, which is claimed to be Poland's biggest and most up to date. Straw pulping will be one of the ventures the plant will undertake in the next few years.

China

A report from Peking indicates that China is moving toward self-sufficiency in the supply of paper, and declares that since last year almost all the newsprint used in the country has been produced at home. Paper mills are said to be producing more than 100 kinds of paper, ranging from cigarette paper to cement bags; most of the paper for educational and cultural uses and part of the needs of industry are supplied from Chinese mills.

Sweden

Norway and Sweden have agreed to open up a better Atlantic supply line for Sweden through the Norwegian port of Trondheim. Expanding dock facilities there and doubling the international rail line are under consideration. Should these plans be approved, Sweden will have available an additional ice-free port and a more direct route for Atlantic shipments.

Brazil

The paper industry continues to expand, although at a rate less than that required for domestic consumption. The principal factor responsible for the slow rate of increase is the shortage of electric power resulting from the high consumption of power characteristic of papermaking. The country is rich in raw materials and, in spite of the critical situation which developed recently in the world market, domestic production still failed to meet the requirements of the internal market. This deficiency was of 100,000 tons annually, valued at 704 million cruzeiros ($37,052,631) an amount representing a little less than one third of domestic production. The deficiency in production is principally in newsprint. Imports of newsprint supply 90% of total requirements.

Available data show that the inflow of investment for the newsprint industry has not been very important. This is explained by the large sums of capital needed and by the demand for advanced techniques, together with the shortage of power. It is stated that owners of land in Paraná are endeavoring to join in a large-scale investment project for developing the newsprint industry, and that studies have been prepared for a large-scale plant.

The Ibessaba group in Amazonia is seeking to utiliže a tree which is abundant in the Amazon area—white imbauba—for the production of paper. Development would depend upon electric power which the company believes it can obtain with the construction of electric power plants provided for in the Amazon Development Plan.

Burma

A pulp and paper mill capable of producing 50 tons of pulp a day is a major project of Burma's comprehensive plan for economic and industrial development. Bamboo will prov the raw material.

No announcement has been made regarding grades of pa to be produced. Should the plan include production newsprint, mechanical pulp would be required to mix w the bamboo pulp.

Canada

The year 1953 was one of the best years in the history of Canadian pulp and paper industry. Over-all producti amounting to some 9.3 million tons with a gross value of $ billion, was about 1% lower in tonnage than the rec figure established in 1951, but about 2% greater than t output in 1952.

According to preliminary reports, 1953 profits of m Canadian producers of newsprint and other paper were little higher, after taxes, than in 1952. Slight increases labor costs were more than offset by reduction of about in the federal tax on corporation profits, effective at the beg ning of 1953.* Most paper companies have paid the sa rate of dividends as in 1952. Firms engaged mainly in p ducing pulp for sale to consumers did not do so well in 19 as pulp prices were down.

There has been no lessening of the dependence of the dustry on the United States market. Shipments of new print to the United States, at 4.8 million tons in 1953, w slightly higher than in 1952 and, as in other recent yea accounted for 85% of total Canadian newsprint productio Total wood pulp exports mainly to the United States, w lower in 1953 than in 1952. Exports of several other pro ucts, such as book and writing paper, wrapping paper, a paperboard, were lower than in the previous year, but t decline was more than offset by an increased demand these products in the domestic market.

No new paper or pulp mills came into production in Cana during the past year, but there was an appreciable incre in the capacity of existing paper mills and of some mi making bleached chemical pulps. Due to the expansion pulp and paper capacity in recent years, in Canada and the United States, supply has caught up with demand.

Market conditions generally were somewhat better in t second half of 1953 than in the first half, and at the end of t year there was no evidence of a decline in demand. On t whole, the industry looks forward to another successful a prosperous year in 1954. Despite some indications of a mi business recession in the United States, exports of newspri and pulp to the United States in 1954 are expected to about as high as in 1953.

Most Canadian pulp and paper companies have used t period of expanding trade since the war to strengthen the financial structures and to make additions and improvemen to their plants. Total capital invested in the industry is nc estimated at more than $1500 million, compared with abo $600 million in 1939. It is often pointed out, on behalf of t industry, that the additional capital investment has be provided largely out of internal resources (depreciation ar depletion write-offs plus retained net profits) without r course to public financing.

Diversification of production and expansion of export ma kets are regarded as strengthening factors for the industr Although Canadian newsprint production has increased b about 65%, production of pulps for uses other than newspri is approximately four times as large as before the wa Canada's share of world newsprint production has risen fro about 40% to about 54%, and newsprint exports from Canac have increased from 75% to 81% of all newsprint moving international trade. The share of Canadian producers world trade in pulp has shown a much greater increase. Befo

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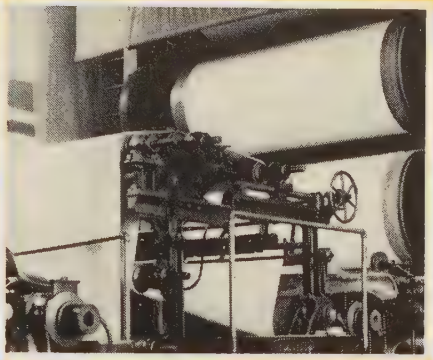
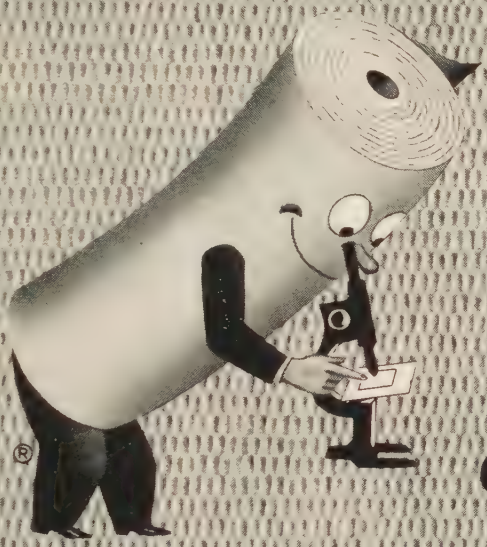
* The rate of federal tax was reduced from 52 to 49%. For Quebec co porations the effective reduction was from 54 to 49%, since an additional 2 formerly paid directly to Quebec province can now be deducted from t federal tax.

SCIENTIFIC CONSTRUCTION*

Makes The Big Difference In DRYER FELTS





WOODBERRY 887 REINFORCED DRYER FELT

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*Asbestos yarns woven into the face of patented Woodberry 887 dryer felts at scientifically determined intervals give you longer wear and smoother operation. Paper mills have learned to count on lowered steam consumption and consistent quality with Woodberry 887. For dryer felts that are low on cost, high on performance, specify Woodberry 887.

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One of a series of comprehensive laboratory controls throughout production to assure uniformity in all Mt. Vernon-Woodberry products. Here fabric thickness after weaving is being gauged.

the war, Canada was shipping between 10 and 15% of all pulp moving in international trade: now the country supplies about a third of this trade and has become the leading pulp exporter in the world.

Industry sources consulted here are confident that Canada, with its important forest resources, cheap electric power, and experienced producers, will be able to keep the leading position it has attained in world production of pulp and paper. It is expected that there will be continued growth of the industry here in order to keep pace with expanding consumption in North America and also in other markets. The recent establishment of new mills and other increases in capacity in the United States are not seen as a challenge of Canada's position as a supplier of the United States market as it is believed that population increase in the United States will create additional demands which must be supplied in large part by Canadian producers. The stand of the Canadian Pulp and Paper Association, representing the industry, is that Canada can be depended upon to supply additional quantities of paper and pulp needed by the United States in future years, by increasing capacities of existing mills or, if necessary, by building new mills.

Finland

Problematic as the fate of the budget seemed at one time, Parliament recently buckled to in earnest to get the job done before a new Parliament is elected. The estimates drafted by the previous government came in for a drastic remodeling in the Parliament's Finance Committee, but although many appropriations were increased and new expenditure introduced, the keynote of the Budget is still austerity.

On February 23 the house went into recess for a spell of electioneering. By that date the general elections were only a fortnight away, and Members seeking re-election had to be given this chance to conduct their campaigns.

Problems relating to the balance of payments between Finland and the U.S.S.R. were the subject of negotiations in Moscow at the turn of January-February, Finland's imports from the U.S.S.R. and the trouble area, in general, which was estimated for 1954 being somewhat below her exports. The Finnish delegation headed by the Minister of Trade and Industry, Mr. Aura, returned on February 8 with an agreement which Mr. Aura described as a satisfactory solution. Under the terms of the agreement Finnish firms have the opportunity to make further purchases from the Soviet Union to shorten the gap, after which the parties are to meet again on April 1. The ultimate deficit will be covered by the U.S.S.R. partly in gold—up to 20 million roubles—and any remainder in Swiss francs and/or pounds sterling.

Over and above this, the U.S.S.R. has granted Finland a gold loan of 40 million roubles—in terms of pure gold 8887 kilos. Finland may draw on this loan during a period of three years either in gold, U. S. dollars, or other currency. The amounts drawn are to be repaid within ten years of the date of drawing in the same currency, or in the case of gold in gold. On the amount of the loan utilized interest will be charged at the rate of $2^1/_2\%$. The use of the loan will be decided exclusively by the Finnish Government.

Sales of standing timber have continued at a brisk rate over the year's end into the present year. Pulpwood prices have tended slightly upward, the rise in the level since the beginning of December being short of 10%. One reason is the increased activity foreign pulpwood buyers have been showing, but the Finnish cellulose and paper industries too have been interested in increasing their stocks of raw materials.

Employed on forest work in February are altogether 160,000 men and 55,000 horses, a slight increase on last year.

Thanks to severe restrictions on imports the balance of trade for last year was favorable in spite of the appreciable fall in the value of exports for all that they increased in volume. But imports will continue to be kept severely in check, and this has had to be taken into account in negotiating trade agreements. For instance automobile imports fr western countries will be very small this year. The lim for imports of automobiles and spares are for the pres down, in the case of the U. K. to £1,000,000 and in that France to 200 million francs.

Iraq

The Iraq Government reportedly has plans for develop a paper industry. Products to be made include newspri wrapping paper, and cardboard.

Sweden

The year-end rush to reduce mill inventories before closi the annual accounts was countered by the producers' des to take advantage of the slightly higher prices posted for t first quarter of the new year. As a result pulp shipments January declined much less than usual, aided by an unusua late Winter and navigation open beyond Umeå in the Bot nian Gulf, and the mill inventories dropped further, to l than 130,000 metric tons, the lowest figure since Februar 1952, when the concerted European resistance to Swedi pulp prices began.

One new development in an otherwise quiet mid-Wint period appears to have been a great reduction in spot sal Local brokers had to hustle for the business available a blamed the change on the increase of integrated pulp-pap mills, the firm but stable pulp market, and increasing don nance of the few very large Swedish pulp mills who funnel the sales through their branch offices abroad. Sales to Ameri continue to average 22,500 metric tons monthly but t buoyant United States demand for unbleached sulphite expected to decline.

The demand for mechanical pulp continues to be unusual strong. Mill inventories were below 10,000 tons at the year end and last year's output limitation is off. AB. Rottner Bruk, Sweden's largest producer of wet mechanical (135,0 metric tons per annum) announced it is building a new m at Slottbron with six machines to produce a further 70,0 tons yearly.

Review of 1953 and 1954 Prospects for Sweden's Pulp and Pa Industry

The vast Swedish pulp industry was blessed with co siderable prosperity and remarkably stable prices dur the last three quarters of 1953. Although the gross volu of sales and the corporate net profits did not approach t record levels of 1951, the industry managed to block wage i creases, avoid rises in other production costs, and sell mo pulp than they made—as evidence by the drop in mill i ventories from over 453,000 metric tons on April first to abou 163,000 at the end of 1953.

In the face of determined European buyers' resistance t high Swedish prices the stability of Swedish production cost averted a serious economic depression. Most of the hig priced pulpwood purchased in 1950 and 1951 during th Korean World War scare was consumed by the mills in th lean year 1952 and the wood purchased in the Winter c 1952–53 averaged from 30 crowns ($5.91) to 60 crow ($11.82) per cubic meter which was almost 50% below th average of 66 crowns ($13) to 78 crowns ($15.37) (dependin on counties) recorded in 1951–52 and close to 1950 level While it is true that pulpwood prices rose almost 20% fro the latter in the 1953–54 cutting season, the threatene forest owners' sellers' strike (seeking a 50 crown (9.85) averag price) has not materialized. *Note:* (1 cord = 2.55 cub meters — solid volume without bark).

The wage outlook has likewise benefited the pulp manu facturers. After three months of desultory negotiations th 40,000 pulp and paper mill workers agreed in mid-February 1953, to a new annual wage agreement at levels identical wit those of 1952. The same thing was repeated this Winter an on Feb. 23, 1954, the same union accepted the mediator'

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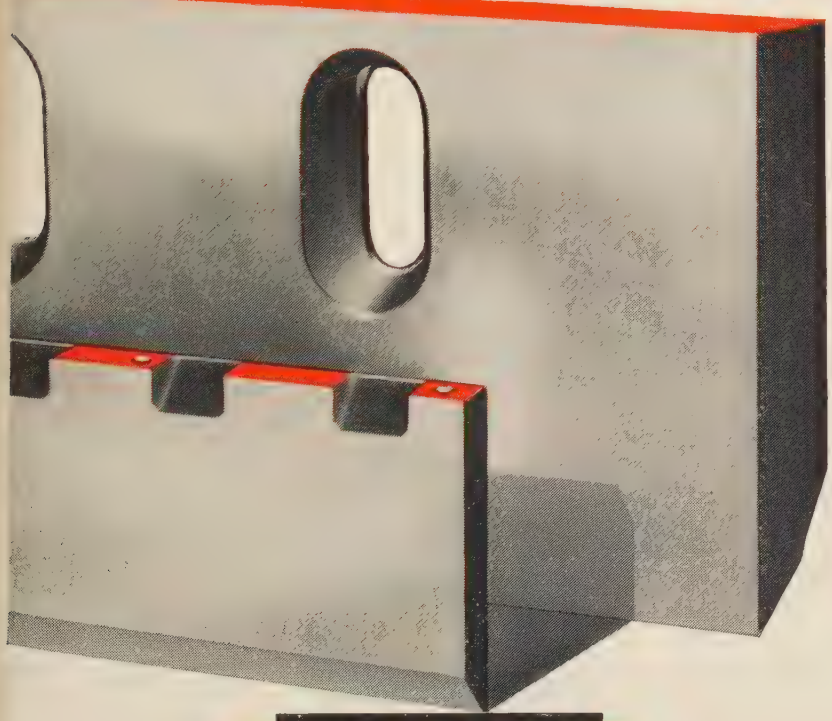

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from pulp to paper

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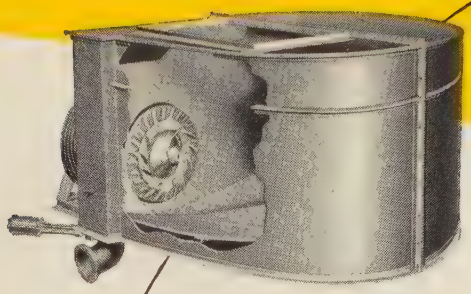

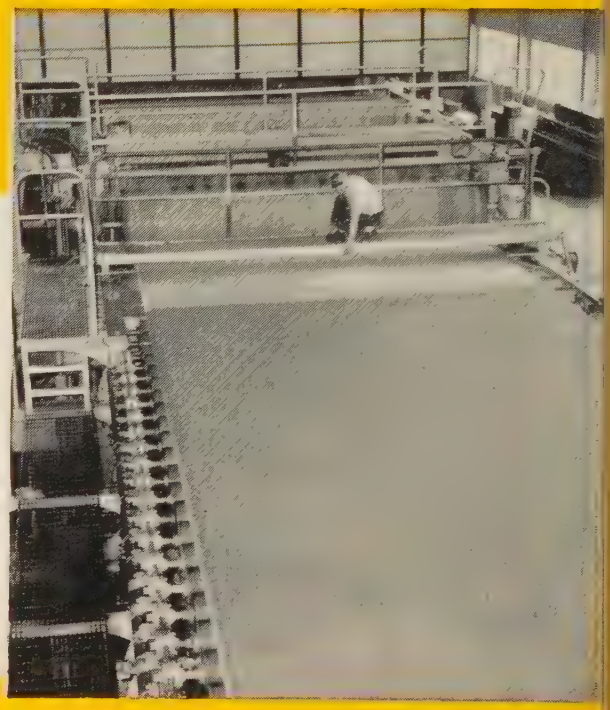

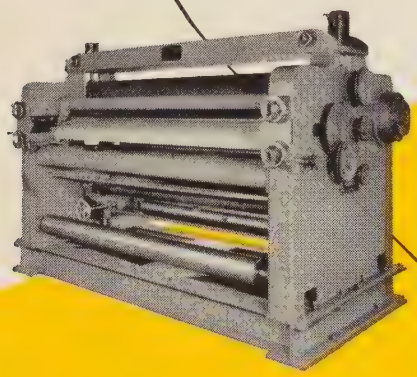

Ability to engineer out of sound
experience and fabricate with precision

Ability to ship on schedule
erect quickly and efficiently, start up smoothly

Ability to perform at any spot
along the way from pulping to converting

That's what mill managements want—that's what they
get when they choose Black-Clawson as their supplier

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suggestion—in this case a 2.4% increase equal to Sw. krona 0.09 ($0.017) per hour for calendar 1954. In November, 1953, the hourly earnings of pulp mill workers averaged 3.83 krona ($0.75) and those of paper and board mill workers; 3.63 krona ($0.72). In this connection it is interesting to note that in a recent official survey† the labor wages in 1951 accounted only for 5.4% of the chemical and 7.2% of the mechanical pulp sales value as against 10.6 and 11.1% respectively, in 1949. The price of wood in 1951 accounted only for 39.8% of the chemical and 44.5% of the mechanical pulp sales value as against 59.7 and 52.2%, respectively, two years earlier. In 1951 fuel costs were 4.1% for chemical and 1.4% for mechanical, hydroelectric power costs were only 1.1% for chemical and 4.6% for mechanical, and office administration costs were 1.0% for chemical and 1.3% for mechanical pulp in that same year. Figures for 1952 and 1953 have not yet been compiled.

The third major advantage is freezing production costs during this delicate "transition period" presumably before a new prosperity wave in Sweden's pulp industry has been the successful introduction of continuous plant operations and other rationalization steps. Selling the proposition to the labor unions took several years but largely through leadership of the Swedish Cellulose Co. at Sundsvall the concept of continuous operations was widely accepted and implemented in the Fall of 1953. As a result the output at the mills adopting the practice has been increased from 15 to 20%, the per capita wages including overtime increased by 8.5%, and the total production costs reduced by 7 crowns ($1.38) per ton of pulp produced or 1%. Rationalization has also taken the form of new paper machines being installed in the large pulp mills of Korsnäs AB and Statens Skogsindustrier AB. It has motivated the rebuilding of the whole Kramfors mill of the Swedish Cellulose Co. It has led to several installations of heat recovery plants, notably Svanö and Dynäs AB to obviate the need for any fuel purchases. Last but not least, rationalization of plant operations has systematically been applied to all plants in eliminating handling steps, unless transportation of odd lots and obsolete machinery or old plant equipment. Although Sweden's 140 pulp mills are old today they have recently been made very much more efficient.

The perennial argument about the desirability of nationalizing Sweden's forest industries was briefly revived last November 11 when a public debate on the issue concluded that it would be better to stress instead structural rationalization and strengthening of the existing government-owned industries such as Statens Skogsindustrier AB.

The industry leaders expect to continue pressing their pulp sales to the American market but do not expect to do as well in 1954 as in 1953. Apprehension of a serious American business recession this year is widespread in certain Swedish management circles and a surplus of pulp production in Canada and the United States is realistically noted to have already affected the world market. However, sales in the first half of 1954 are much greater than in the first half of 1953 so only a sharp drop in the second half year would lead to a 1954 tonnage figure below last year's total. Furthermore, pulp prices to the American and other markets are slowly rising all along the line so larger dollar earnings appear to the Embassy to be likely to result. Sweden's deficit in trade with the United States was cut from 512 million crowns ($100,864,000) in 1952 to 149 ($29,353,000) last year and at least half of the 773 million crowns ($152,281,000) earned in sales to all dollar markets in 1953 resulted from sales of pulp and paper. The official Swedish pessimism on dollar sales prospects in 1954 is therefore not fully justified by the facts at hand. Pulp sales to the traditional European market are officially expected to be at least as large as in 1953 and certainly should yield greater returns because of rising prices.

The fluctuations in pulp prices were less pronounced last year than in any period since 1949. The average prices for 1953 approximated 314 crowns ($61.86) for dry and 344 crowns ($67.77) for wet mechanical pulp, 500 crowns ($98.50) for unbleached, 690–730 crowns ($135.93–$143.81) for bleached chemical, and 897 crowns ($176.71) for dissolving or rayon pulp.

The domestic paper consumption in Sweden increased by 35,000 metric tons over 1952 to attain a record of 520,000 tons last year. Of this 1953 total domestic consumption consisted approximately of 97,000 tons of kraft wrapping, 54,000 of sulphite wrapping, 132,000 of newsprint, 8000 of greaseproof and glassine, 40,000 of magazine papers, 64,000 of fine papers, 50,000 of other papers, and 76,000 of boards. The latter figure includes boards under 350 grams per square meter which Swedish customs statistics classify as paper but the Papermills Association considers as board. The outlook in 1954 is very favorable with possibly a further increase in the consumption of kraft, sulphite, and magazine papers.

The Swedish Papermills Association abolished years ago the practice of setting domestic paper prices. It is now proposing to discontinue the maintenance of any price statistics because of the stability of present prices and the wide diversity of paper grades produced in Sweden. Domestic prices are said to closely approximate the average export prices being generally only 5 or 10 Swedish crowns ($0.99–$1.98) below the f.o.b. export quotations shown there. During 1953 the export prices were remarkably uniform for newsprint, quite unsettled for board cellulose wadding and fine papers, and very gradually declining for wrapping papers of all grades.

† Kommersiella Medellanden (Bd. of Trade organ), January, 1955, p. 17.

Sweden's Exports of Paper, Board, and Pulp

	Average prices f.o.b. in kroner per metric tons (conversion APPA)													
	Jan. '53		*July, '53*		*Dec., '53*		*1953*		*1952*		*1951*		*1950*	
	Krs	*$'s*	*Krs*	*$'s*	*Krs*	*$'s*	*Krs*	*$'s*	*Krs*	*$'s*	*Krs*	*$'s*	*Krs*	*$'s*
Paper and board														
Board	892	173	729	141	756	146	815	158	1229	238	1362	264	721	140
Newsprint	658	127	638	124	640	124	637	123	857	166	1091	211	518	100
Glazed ppr.	1825	353	1682	326	1563	303	1605	311	2044	396	2815	545	1737	336
Book ppr.	1108	215	1225	237	1160	225	1137	220	1522	295	2037	394	935	181
Coarse tis.	1321	256	1145	222	1242	240	1211	234	1709	331	2097	406	1036	201
Kraft ppr.	963	186	866	168	851	165	882	171	1336	259	1531	296	732	142
Sulphite wr.	1143	221	1035	200	947	183	1052	204	1535	297	1751	339	885	166
Other wr.	835	162	743	144	771	149	791	153	1241	240	1693	328	733	142
Grease. and glass.	1372	266	1320	256	1298	251	1305	253	1792	347	1887	365	949	184
Others	1111	215	1053	204	983	190	1056	204	1629	315	2076	402	991	192
Cell. wad.	1571	304	1475	286	1508	292	1634	316	2168	420	2458	476	1426	276
Wood pulp														
Mech. wet	327	63	340	66	348	67	344	67	433	84	482	93	254	49
Mech. dry	338	65	307	59	318	62	314	61	382	74	716	139	330	64
Bl. sulphite	706	137	674	130	721	140	688	133	1035	200	1450	281	647	125
Unbl. sulphite	551	107	500	97	545	106	526	102	926	179	1379	267	513	99
Bl. sulphate	736	142	704	136	732	142	731	142	1047	203	1485	287	675	131
Unbl. sulphate	489	95	469	91	483	94	480	93	899	174	1360	263	484	94
Dissolving	942	182	858	166	870	168	897	174	1402	271	1485	287	680	132

In mid-June a 10 to 12% cut in wrapping paper prices started a delayed buying move but board remained weak until October.

There were several significant changes in Swedish exports besides the 27% increase over the tonnage exported in 1952, bringing last year's total close to the record levels of 1950 and 1951. British purchases increased substantially (about 20%) for all grades except in newsprint which declined by 40%. Sales to France last year were less than 60% of the tonnage sold in 1952 because of inflexible French import restrictions and French payment difficulties still unresolved. Exports to Western Germany of various wrapping papers soared but other paper grades were virtually unchanged. Danish purchases rose somewhat and shipments to Italy doubled in newsprint and kraft but otherwise remained small. Newsprint sales to Egypt rose 50% to 6000 tons and sulphite wrapping doubled to 2650 tons. The Union of South Africa bought less board and almost no newsprint but other grades moved as before. In the Western Hemisphere newsprint sales to the United States declined from 16,086 tons in 1952 to 14,200 last year, but kraft rose from 5012 to 12,696, sulphite wrapping from 879 to 1334, and board from 997 to 2192 metric tons in 1953. Exports to Brazil boomed, notably newsprint, the sales of which moved from 14,565 tons in 1952 to 25,417 last year. Sales to Argentina were beset by balance of payment problems and newsprint sales recovered only from 196 tons in 1952 (sic) to 4000 last year. Shipments to Australia remained strong, notably in newsprint which rose from 17,009 to 25,566 metric tons but Swedish trade circles are upset by the £21 per ton ($46.95) Australian tariff duty which became effective in 1954 and is a 50% increase in the excise on Swedish kraft and sulphite wrapping. Protests have so far proved in vain.

The Swedish paper industry appears confident that without increasing prices it will achieve in 1954 unprecedented production and record exports, in tonnage if not in value.

Venezuela

The Corporacion Venezolana de Fomento has made a public announcement that it will build a plant for the manufacture of paper pulp from sugar cane bagasse. The plant is designed to produce 15,000 metric tons of pulp annually.

Israel

A major stride forward in Israel's campaign for economic self-sufficiency was taken with the opening of the $2,500,000 and IL.1,250,000 plant of the American-Israeli Paper Mills Ltd., which will fill virtually all the paper needs of the young country.

The plant, largest and most modern in the Middle East, marks the first large-scale effort by "The People of the Book" to produce paper in variety and quantity. The mill was officially opened by the Acting Prime Minister, Moshe Sharett, at a gala ceremony, attended by six Cabinet Ministers, representatives of the American Embassy, and more than 1000 leaders of Israel Government, industry, and public bodies.

The plant, which will turn raw pulp into finished paper at an annual rate of 12,000 to 15,000 tons and thus save Israel $1,000,000 in hard currency per year, is a true international enterprise. American-Israeli Paper Mills was founded on the initiative of the Mazer family, owners of the Hudson Pulp & Paper Co., New York, and the Palestine Economic Corp.,–U.S.A., and includes other investors from Latin-America, Australia, Europe, and Israel.

Joseph Mazer, treasurer of Hudson Pulp & Paper, is chairman of the board of AIPM, Heinz Gruenbaum, executive vice-president of the Palestine Economic Corp., is vice-chairman.

The construction-erection program was also undertaken by an international team. The plant, 100% American in design, was planned by Merritt-Chapman & Scott, Inc., which supervised its construction in cooperation with managem personnel. Paper experts and construction specialists fr the United States, Scotland, and Switzerland worked toget with Israelis—hailing originally from several do countries—to erect the steel-reinforced concrete plant o 22-acre site directly on the main highway between Isra two biggest cities of Tel-Aviv and Haifa.

Despite the difficulties inevitable in a pioneer country, plant was completed on schedule. The plant was in operating condition eighteen months after ground broken, the construction-erection program requiring no lon than would be needed to complete a similar plant in United States.

Since Israel has no tradition of papermaking, the compa has launched a training program designed to provide lo replacements for all the foreign experts at the plant wit two to five years. Under this unusual program, the pl has two sets of employees in major technical and manage positions—one set made up of foreign experts called "teach operators," the other set composed of Israelis training to t their places.

The mill, which has one paper machine, will produce kra newsprint, groundwood-content and groundwood-free writ and printing papers. The production schedule of the pl is so set up that it will be able to meet all the requirements Israel in the above-named grades. This will be done by r ning a minimum of one week in each grade with changeov and washups performed only on the normal shutdown d The mill, which is rated at 12,000 to 15,000 tons a year wh producing the above grades, will produce six days a week a maintain and wash up on the seventh day.

The production design of the mill was based on Isr market surveys undertaken in 1950, 1951, and 1952. T mill was, however, designed and built with a view to sw expansion, justified by growing demands.

The mill, located exactly halfway between Israel's cH port and industrial center of Haifa and the principal comm cial city of Tel-Aviv, occupies only 2½ acres of the 22-a plot at present—the balance being held in reserve for plan eventual expansion. The mill includes storage facilities 4000 to 5000 tons of pulp and for six months' supply of ot raw materials.

The mill, built of reinforced steel concrete with Trans wall sidings and reinforced concrete roof slab construction, so designed that all the chests, pumps, vacuum equipme and all auxiliaries of the paper machine, together with t machine shop, boiler room, and finishing room, are located the basement level. The paper machine, laboratory, a stock preparation room are located on the first-floor lev All master electrical controls and preparatory and save-equipment are located on the mezzanine level. A 10-t crane is maintained on the operating level to traverse t complete length of the operating floor for maintenan purposes. The elevators connect the various levels of t plant.

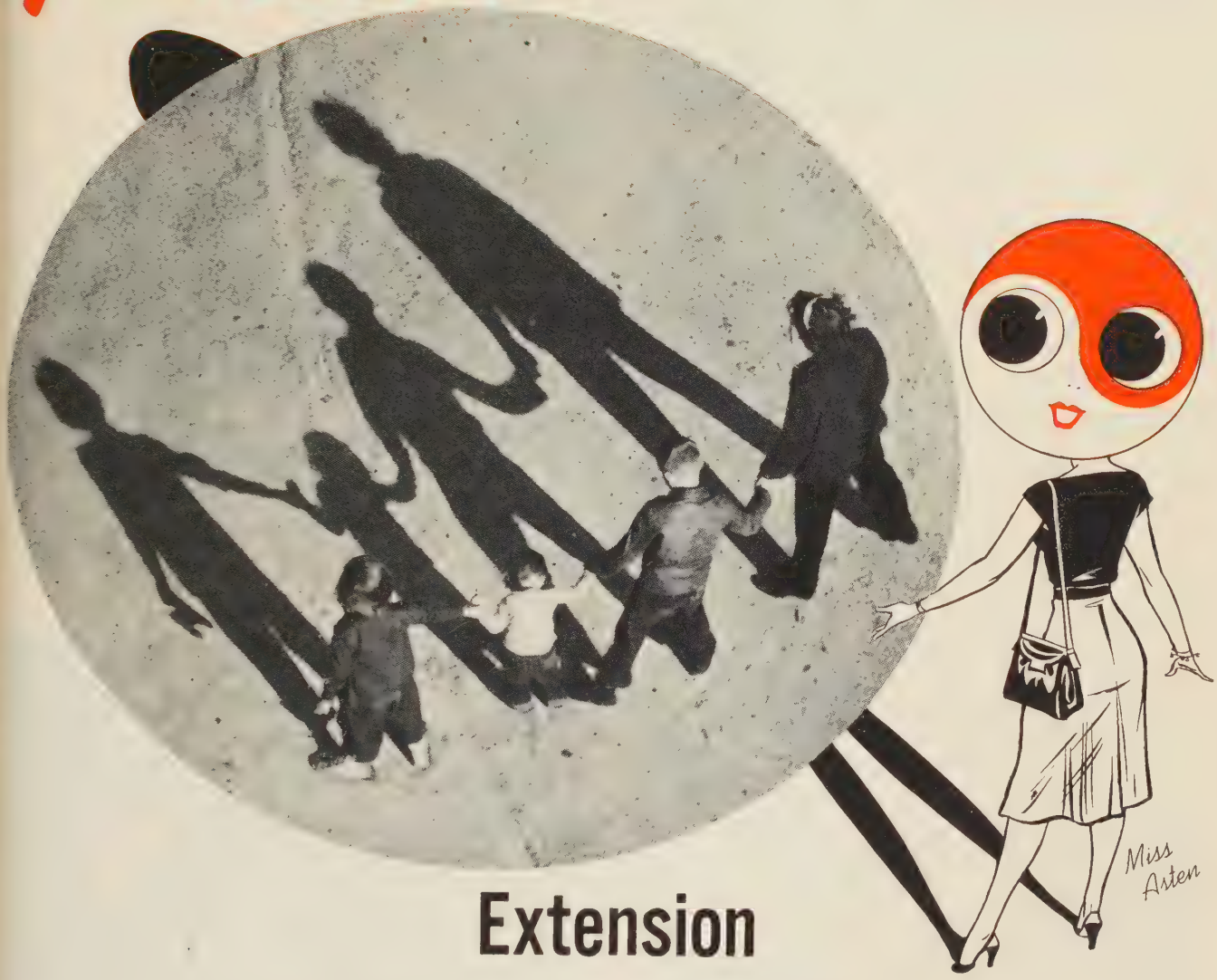
Stock Preparation

Pulp is transported from the pulp storage room to a Shar Hydrapulper (2½ tons at 5%) by means of conveyor. T pulp is dumped into two pulp storage chests, each havi a capacity of 5 tons. In the production of groundwoo content papers, the chests are used as blending chests. Wh kraft, sulphite, and bleached papers are made, these ches are used for straight storage.

A bank of five Mordens is located directly adjacent to the chests. The Mordens, each of which is powered by a 300-h motor, are so set up that they can be used in parallel, in seri in part, or completely by-passed.

Directly after the Mordens is located a Trimby Pr portioner used for the blending of fibers or for recycling ba through the Mordens.

Asten DRYER FELTS



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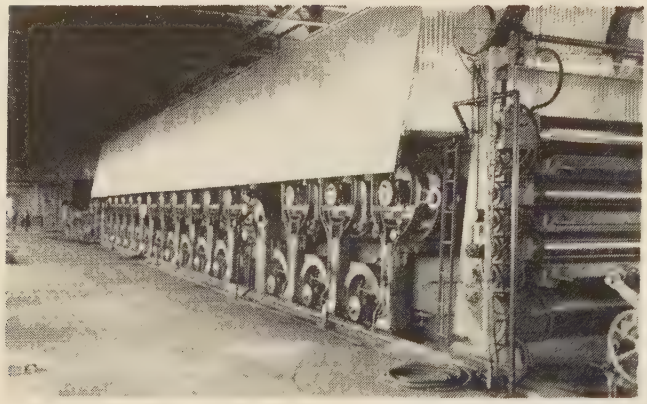


View of the Paper machine

From the proportioner, the stock is passed to the machine chest, which has a $2^1/_2$-ton capacity. A consistency regulator, located adjacent to the machine chest, is directly before two Jones machine jordans. Each jordan is powered by a 300-hp. motor. A stuff box is located after the jordans and before the mixing box. All piping above 4 in. in the mill is transite.

Machine Room

The paper machine, which was built by Bertrams Ltd., of Edinburgh, Scotland, has a Sandy Hill-type headbox which is preceded by a Jones stainless steel screen. The wire is 136 in. wide and 85 ft. long. The fourdrinier is of the cantilever type for quick wire changes. The wet end has a dandyroll frame which is detachable when not in use.

Both press sections are pneumatically loaded. The first press is a suction press with a Stonite top roll and a rubber-covered bottom vacuum roll. The second press is a straight press with a Stonite top roll and a rubber-covered bottom roll. The drier section has 27 driers, a wet smoothing press, and a size press. There is a seven-roll calender stack followed by a Pope reel and a Bertrams rewinder.

Located on the machine floor is a roll trolley for the purpose of transporting rolls to an elevator for delivery to the shipping or finishing rooms. A hatchway at the lower end of the machine room floor is located directly over the Lobdell roll grinder; thus, the overhead crane can lower any roll directly onto the grinder for maintenance.

The paper machine is so constructed that the drive is good for 1000 f.p.m. The drying capacity of the machine is for 75 tons. The machine is laid out in such a way that additional driers can be installed without removal of any equipment. The machine is driven by a G.E. steam turbine.

Boiler House

The boiler house currently contains a Combustion Engineering boiler designed and built to deliver 65,000 lb. of steam at 700 p.s.i. with superheat. The boiler room is designed to permit the future installation of the mill's independent electrical power turbine. In the initial stage of operation the mill will purchase all of its electrical power and the boiler will therefore be used solely for the delivery of up to 40,000 lb. of steam per hour for process and turbine drive.

The boiler room was designed and built with expansion in mind; the boiler room has been laid out and footings have already been built for the installation of a second boiler. The boiler house contains zeolite water treatment. Boiler feedwater can be delivered either through an electrically driven boiler feedwater pump or an auxiliary steam turbine driven boiler feedwater pump.

Water System

The mill receives its water from a well located on the property. The well has a capacity of up to 1,000,000 to 1,200,000 g.p.d. The water goes from the well to a 12-hr. capacity storage tank and is pumped from there to the m fresh water chests. The outside water tank has an e trically driven pump as well as an auxiliary diesel dri pump. The mill maintains a very closed system using Oliver vacuum saveall. What white water is not utili for makeup, pump seal, white water showers, etc., is pas through the Oliver. The effluent from the Oliver is charged in the Hadera River. The complete water syst is equipped with alarm type float valves.

The mill, which is now using 750,000 to 1,000,000 g.p.d., investigated the question of water availability for future pansion and has found that a sufficient amount of additio water can be made available through digging of wells wit the plant site.

Finishing Room

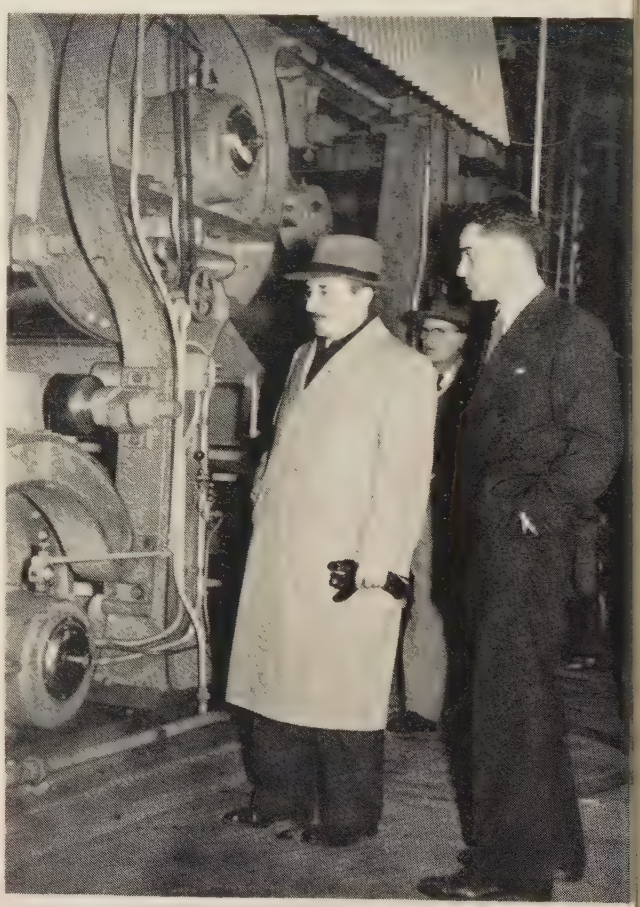
The finishing room contains a Hamblet sheeter with Maxim layboy, a Cameron No. 10 rewinder, and a Sayb cutter. The mill will sheet approximately 50% of its p duction. The sheeter and rewinder take an 8-in. trimm roll. The finishing room contains the latest in mater handling equipment, including overhead hoists and flo level roll turntables.

The shipping room is located at one end of the finishi room, and rolls coming from the machine room on a 20-t elevator can be deviated via the turntable either to t finishing room or the shipping room.

One entire side of the mill has a loading platform, which used for shipping and receiving purposes for all departmen

The plant laboratory is set up to perform pulp testing a all physical and chemical paper testing.

The plant also includes a separate office building whi contains offices for all administrative and sales personnel.



Official opening of American-Israeli Paper Mills Lt L. to r.: Prime Minister Moshe Sharett and Robert Zia (of Philadelphia), general manager of the mills

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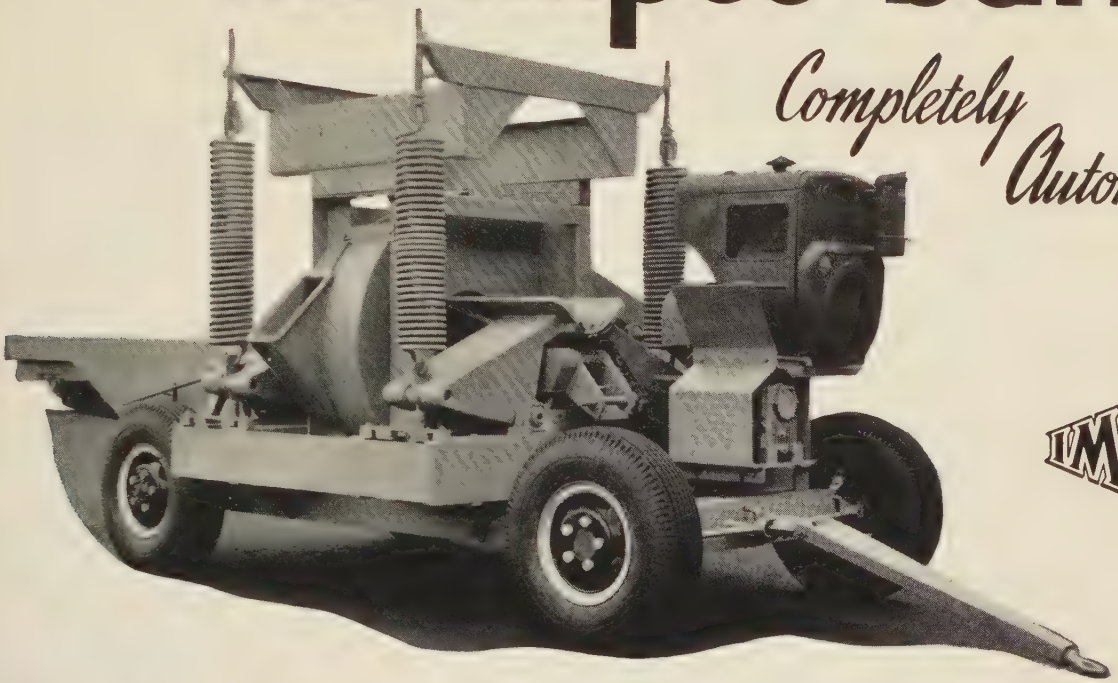

IMPCO

Easily handles irregular shaped logs!

The Impco Barker has been developed to meet today's high bark removal requirements combined with low wood loss.

It is available as a stationary unit for general wood yard barking or as a portable unit mounted on a heavy frame equipped with tires for highway towing. The mobile unit can be furnished with a self-propelling drive for moves between barking sites.

Capacities up to 20 cords per hour depending on conditions, size and type of wood can be expected.

Specifications:

Wood size—
4′ to 8′ in length, 4″ to 18″ in diameter
Feed Rate—
30 to 120 f.p.m.
Infeed and Outfeed Conveyors—
Automatic self-centering self-sizing
Barking Tools—
6 springloaded—automatic sizing for variable log diameters
Bark Discharge—
Mechanical ejection
Drives—
Gasoline or electric powered

IMPROVED
MACHINERY INC.

NASHUA • NEW HAMPSHIRE

Sherbrooke Machineries Limited, Sherbrooke, Quebec, manufacture similar equipment in Canada

F 1-a

Pulp

Pulp for the mill is received in bale form, currently from the Scandinavian countries. The corporation and the Government of Israel are performing tests looking toward the possibility of eventual use of local forestry and other resources for pulp.

Personnel

The managerial and supervisory personnel of AIPM has a background of long experience in the paper industry. Robert Zion, managerial employee of the Hudson Pulp & Paper Co., was assigned to serve as general manager of AIPM for the initial construction-erection and production period, and will remain in that position until the Israeli management personnel is ready to take over. John Milan, former superintendent of the Southland newsprint mill of Lufkin, Tex., of the Union Bag mill at Savannah, Ga., and of the National Container mill at Jacksonville, Fla., is serving as the first general superintendent of the AIPM Mill.

Papermakers have been hired by AIPM in the United States, Scotland, and Switzerland. They include A. C. McKeithen, formerly with the International Paper Co., R. B. Hutchison and Daniel V. Forrest, both of Penicuik, Scotland, and Werner Egger and Paul Alisser, both of Switzerland.

Under the direction of this staff, local machinists, pipefitters, boiler operators, electricians, and other technicians are being given specialist training to meet the specific demands of the paper industry. All papermaking production personnel are being trained from a green labor pool. This labor pool was formed primarily from among personnel who worked in the construction-erection program.

Texas

Suppliers in other states ship $104,475,000 worth of paper and paperboard products into Texas annually.

This figure was estimated by James R. Bradley, assistant research economist of the Texas Engineering Experiment Station, who samples markets in survey by means of the out-of-state purchases technique. He achieved a 22% sampling from 720 questionnaires mailed to a representative group of manufacturers, wholesalers, and retailers in the paper and paperboard industry. He used the total employment of his sampling of firms and total employment of the 720 firms as the ratio by which to estimate total out-of-state purchases.

The estimated purchases by main categories are presented in the accompanying table. All purchase figures presented are

Out-of-State Purchases of Paper and Paperboard Products by Texas Organizations, 1952

Product group	*Purchases*
Newsprint	$ 16,295,000
Groundwood paper	3,072,000
Book paper	4,697,000
Fine paper	5,436,000
Coarse paper	4,916,000
Tissue paper	4,482,000
Absorbent paper	347,000
Roofing	9,800,000
Container board	2,532,000
Setup boxboard	316,000
Cardboard	950,000
Office supplies	591,000
Stationery	10,040,000
Tablets and related products	845,000
Paper products for printing	1,447,000
Wrapping products	5,786,000
Containers, general	9,438,000
Sanitary food containers	4,403,000
Packaging accessories	1,791,000
Sanitary health products	12,040,000
Food serving products	2,349,000
Miscellaneous paper products	2,902,000
	$104,475,000

wholesale. At present four paper mills, one paperboard m and three pulp mills are operating in Texas. Plant facili of the eight firms represent a total investment of appr mately $89,000,000.

Forest land in Texas is estimated at about 10,500,000 ac

Virginia

The Governor of Virginia signed S.B. 272 on April 21, 19 This bill provides that a taxpayer may elect, for years ginning after June 30, 1954, to amortize the cost of cert plants, equipment, and lagooning for pollution control o a period of 5 years.

Sulphite Roadbinder

The Lake States Roadbinder Association, P.O. Box 4 Appleton, Wis., has published a booklet giving informat on roadbinder made from spent sulphite liquor.

Southern Forests

The Southern Forest Experiment Station, New Orleans La., has published its 1953 annual report, giving details work in progress at the Station, including fundamental stud of the genetics and soil problems of southern forestry.

Wisconsin

Averill J. Wiley, technical director of the Sulphite P Manufacturers' Research League, has been awarded a cert cate of merit from the Nash Conservation Awards Progr for his outstanding contributions in reducing sulphite stre pollution.

The Research League has announced a $27,000 resea project for fundamental study of lignin in spent sulph liquor, to be carried out at The Institute of Paper Chemist

I.P.C.

The Institute of Paper Chemistry, Appleton, Wis., h initiated an investigation in forest tree genetics and breedi

Maryland

The Northeastern Forest Experiment Station, U. S. De of Agriculture, Upper Darby, Pa., has published a re giving forest statistics for the eastern shore of Maryla This is the third of a series of reports on Maryland fores

Northeastern Forests

The annual report for 1953 of the Northeastern For Experiment Station, U. S. Dept. of Agriculture, Up Darby, Pa., has been published, giving progress in for management and results of investigations made by t station. Methods of establishing plantations of hybrid po lar cuttings are discussed in the station's paper No. 6 Recent Research Notes published by the station give i formation on hand-sprayer control of the white pine wee the effect of ammate on unwanted growth in oak-yell poplar stands in New Jersey, and a mouse census in a spru fir-hemlock forest in Maine.

Bamboo

The bamboos possess several characteristics which ma them promising as profitable domestic crops. For instan they grow very rapidly, and they have many commerc uses. Substantial markets for bamboo products ha existed in the United States for many years. Bamboos crops are not entirely unknown in this country since vario species have been, and are being, grown successfully for co mercial sale.

The uses of bamboo are almost infinite. In the Orie particularly, it is said that most human needs can be su plied by bamboo; the young shoots of many species are us for structural purposes, furnishing shelter, weapons, bridg water pipes, paper pulp, and soft boards, etc. Still oth

Dependable Source for Chemical Raw Materials

W. A. Kirkpatrick (left), Vice President and Technical Director of Allied Paper Mills, Kalamazoo, Mich., inspects automotive catalog printed on a new Allied stock with Robert W. Hagemeyer, Wyandotte representative, and Clinton J. Wainwright, Allied Sales Representative (right).

"We look to Wyandotte for current needs, and help on future developments"

— W. A. Kirkpatrick, Allied Paper Mills

"We specialize in the manufacture of fine printing papers for both letterpress and offset," states W. A. Kirkpatrick, Vice President and Technical Director, Allied Paper Mills, Kalamazoo, Michigan.

"Due to our hard-water supply and our re-use of wash waters, it is almost mandatory that we use sodium hypochlorites for bleach. Previous experience with calcium hypochlorite showed us that it limed-up in our tanks and washing equipment . . . we don't have this trouble with sodium hypochlorite, and we also feel that we get a cleaner, better color. Wyandotte worked closely with us in making this change.

"We use Wyandotte Caustic Soda for cooking old paper stock and de-inking. Wyandotte representatives and their research organization have been very helpful to us in our regular production, as well as on special projects. For example, Wyandotte helped us greatly in the development of our new three-stage bleaching operation (one of the most complete and finest in the industry). This development enables us to get fibers from waste paper fully equal — and in some respects, superior—to virgin pulp."

How about your business? Wouldn't you be better off with a supplier of chemical raw materials, large enough to take care of your requirements even in periods of short supply, yet interested enough in your current needs and future progress to be always available for technical assistance? Write Wyandotte now. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.*

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CHEMICALS

HEADQUARTERS FOR ALKALIES

Soda Ash • Caustic Soda • Bicarbonate of Soda • Chlorine
Calcium Carbonate • Calcium Chloride • Glycols • Synthetic Detergents • Agricultural Insecticides • Soil Conditioners
Other Organic and Inorganic Chemicals

species, cut into strips of various sizes, are used in weaving a type of coarse cloth, and bags, baskets, and other items.

The uses to which bamboo has been put in the United States are not as varied as in the Orient, but increasing interest in bamboo has been shown in recent years, particularly for such purposes as light but strong construction, concrete reinforcement, and pulp and soft board manufacture. Several commercial organizations are engaged in studies of some species of bamboo for specific uses. For instance, one organization is interested in using this type of material in building boards. In addition, other companies have expressed interest in bamboo as a raw material for roofing and building felts. Other possible outlets for domestically grown bamboo include the manufacture of a corrugated medium for containers, and book or wrapping papers.

One of the most significant facts about the bamboos is that they have been used successfully in several countries as a paper pulp source. This would indicate that bamboo might be an answer to the increasing need for an additional pulp source in this country. This looks particularly attractive when one considers that six or seven times more cellulosic material could be obtained per acre per year from a bamboo forest of the larger species than from a pine forest. If bamboos were used only to take care of the expected increased consumption of southern pine stands for pulpwood, it would have an annual volume potential equivalent to about two and one-half million cords of pine. Bamboos grown in this supplementary capacity would permit the drain and growth of pine woodlands to be brought into balance more easily. As such, the bamboos would offer assistance to the forester and would be a valuable asset to the sections of the country in which they are grown.

Perhaps the most important use to which bamboo could be put in this country, other than in the manufacture of paper pulp, is that for light weight but strong construction. The application of modern fastening methods to the joining of bamboo shows promise in greatly increased speed and adaptability of bamboo construction. Ladders, scaffolding, temporary trestle work, and many other forms of construction could be more portable and more easily handled by using bamboo culms. There are numerous other products from, and uses for, bamboo. Among the products is a wax, melting from 79 to 80 °C. and possessing in general the properties of carnauba wax, and tabashir which has been found to have wide application as a catalyst because of its microporous structure.

As a plant the bamboo is very interesting. The *Bambuseae* tribe is a member of the huge family Gramineae and bamboos are, therefore, near relative of corn, wheat, oats, barley, and other grasses. They are distinguished from other members of the family in that they are woody perennials, some of which are giant species attaining heights of 70 or more feet. The estimated number of species of bamboo ranges from 500 to 1000, composing some 60 or more genera.

Bamboos grow very rapidly, attaining their full height in six to eight weeks. Because of this rapid growth, both above and beneath the soil, very few other plants can interfere with their growth. They also differ from other woody plants in that the full diameter is attained when the culm is only a few inches high. There are several other factors which make the bamboos attractive from the cultivation viewpoint. They are not affected to any appreciable extent by disease, and they are generally easy to propagate and can be harvested without difficulty. In one method of harvesting, called strip or partial harvesting, machine harvesting methods may be applied. This of course, considerably reduces the labor required for selectively cutting only mature canes. Machine harvesting also could be used for clear cutting the bamboo, but strip harvesting has an advantage in that quicker regrowth occurs when the cut sections are interspersed with uncut sections.

Of the two general types of bamboos, the running bamb are generally hardier than the clump forming types and m be successfully grown in all portions of the United Sta except in mountainous regions. They are now being gro in Alabama, Florida, Georgia, Louisiana, Mississippi, So Carolina, Texas, and the eastern parts of North Caroli and Virginia. The clump forming types are successfu grown in southern Louisiana and Florida. The term har has been generally accepted as referring to bamboos wh are evergreen at temperatures down to about 5 °F. N 0 °F. the leaves of all but the hardiest are killed, and a few degrees below zero the stems are partially or complet killed. If, however, the roots are reasonably well protect from the cold, new shoots may develop after winters as c as −20 °F. It has been estimated that more than 50 milli acres of marginal land in the southern United States are su able for bamboo cultivation.

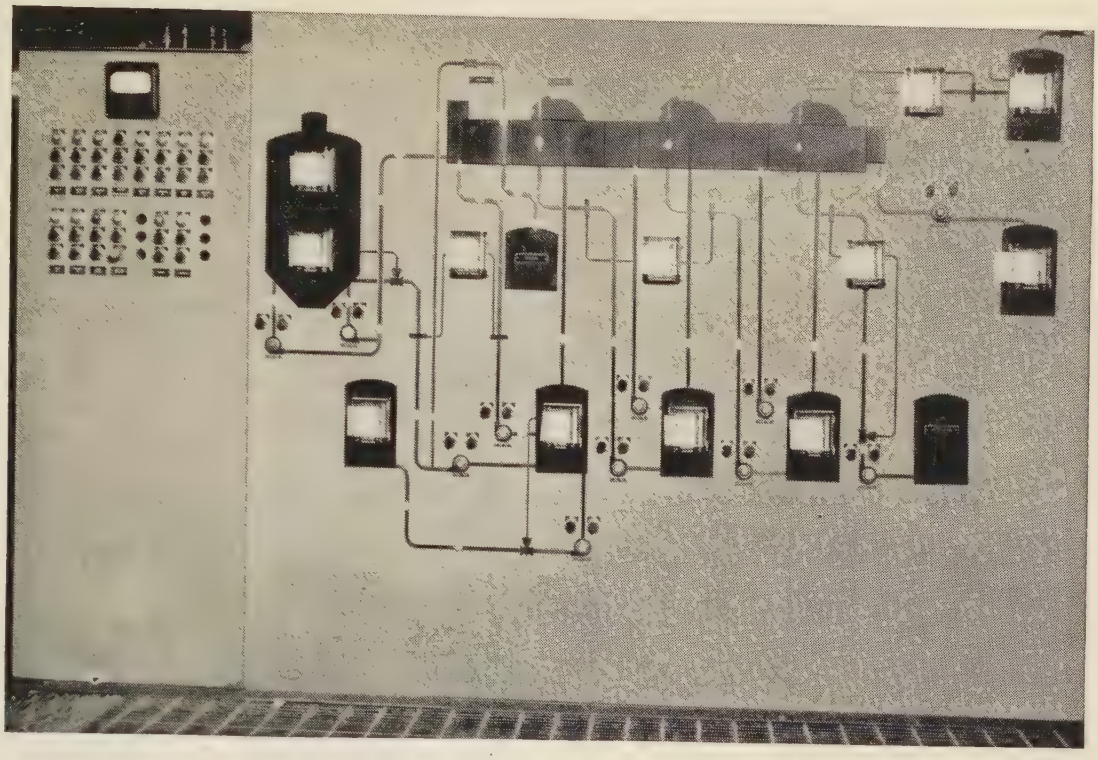
Some indication of the value of bamboo as a possi domestic crop can be obtained by considering the gr return per acre. Growing of the species *Phyllostachys au* for use as fishing poles should be profitable, since report yields and values per pole have indicated that a gross retu of $170 per acre per year could be realized, and once est lished, the bamboo groves would require little care. Althou the market is limited at the present time for the larger po from such species as *Phyllostachys bambusoides*, it appe that a gross return per acre of a species of this size would about $350 annually. It has been mentioned previous that the yield of cellulose per acre from bamboo would about seven times greater than from pine. It would logical, therefore, to assume that land devoted to growi bamboo as a pulp source would bring a return to the ow of approximately seven times that of land used for pulpwo production. On the basis of $13.50 per cord or $9.00 p ton for pine and assuming that bamboo could command comparable price, this would present an annual gross inco to the growers of approximately $100 per acre of land per ye

Although no actual monetary value can be given to bam grown on individual farms for use around the farms, ba boo planted for this purpose conceivably would resul considerable savings to the farmer. In fact, for the p several years, the U. S. Department of Agriculture has reco mended that individual farmers grow about one acre of ba boo for the many uses to which it can be applied on the fa A small grove of bamboo would provide the farmer wi plant stakes, bean poles, fishing poles, and other simil items. The material would also be useful for open constru tion such as shade houses, poultry coops, and fruit a vegetable crates. Also the leaves of many species, bo fresh and silaged, make excellent fodder for farm sto Bamboo grown for use as a landscaping material is anoth potential source of income for the farmer, and in the case the development of large industrial uses of bamboo, the sm tracts of the individual farmer might be worth-while inve ments since they would be excellent sources of propagati material.

Much experimental work already has been done, partic larly under the auspices of the U. S. Department of Agric ture, which operates the Barbour Lathrop plant introducti garden on the Ogeechee River near Savannah, Ga. E periments have been conducted on about 173 species of ba boo. Under the same sponsorship, an industrial survey h been conducted at the Georgia Institute of Technology, a currently, certain experimental work is under way at Cle son College, Clemson, S. C., and at the Herty Foundati Laboratory at Savannah, Ga. These experimental progra are a step toward developing into a crop this plant with future that should eventually provide farmers of this count with a money making crop beneficial to the entire countr

—by H. H. Sineath and P. M. Daugherty, in *Chemurgic Digest*, Februa 1954.

HOW MANY STEPS



can this graphic panel save YOU?

Only you can figure out the steps—and the valuable time—you would save with a Taylor Graphic Panel, similar to the one shown above, in use at the plant of a well-known northwestern paper manufacturer. The Taylor TRANSET* Recorders show the whole picture of the pulp washing process, from the blow tank, through the knotter, and the three stage washer to the brown storage tank.

By looking at this one panel, the operator can tell the level and consistency in the blow tank, flow of all the liquor to all stages of washing, level of the liquor in all three filtrate tanks, level in black liquor storage, level and flow of the white water, and level in the brown stock storage tank.

Taylor Controls automatically regulate consistency in the blow tank, flow and tank level of the liquor wherever required, and flow and level of the white water.

One man can keep tabs on the entire process and, with the help of Taylor Controls, keep flow and level at all stages just where he wants it. In fact, a single operator started up this new plant in five minutes, without an error.

Taylor Graphic Panels for Bleach Plants, Stock Handling, Screen Rooms, Digesters, etc., can be designed for your individual requirements. Ask your Taylor Field Engineer, or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

*Reg. U. S. Pat. Off.

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

Lightning Control

Lightning bolts can be bent to prevent forest fires, according to Fred Herbert, California state forester. In six experiments in northern California last Summer, vertical lightning bolts were transformed into horizontal sheet lightning which never struck the ground.

Forest Tree Planting

The Department of Agriculture reported that tree planting in the year June, 1952, to June, 1953, reached a record 715,548 acres, 193,000 acres (37%) more than was planted in the year ending June 30, 1952. Of the total acres planted, 77,612 were on federally administered lands; 63,791 on lands administered by the states or other nonfederal public agencies, and 574,145 on privately owned lands. Private land planting was 168,000 acres over that of 1952. Ten paper companies supplied 44,561,000 trees from their own nurseries.

Economical Paper Sizes

You can design and produce a job of almost any size or shape, if cost is no object. But if you are trying to get the most mileage for your paper dollar, take a good look at the following table which suggests 12 most efficient sizes that cut with minimum of waste from standard size readily available sheets. This material was prepared by the S. D. Warren Co. and appeared in their booklet, "Printing Papers and Their Uses."

Economical use of printing papers is achieved by planning folders and booklets to cut out of the regular sizes of printing papers. However, in thus planning, it is necessary to allow for the fact that printed booklets must be trimmed after folding; and that it is advisable to allow for a small trim when printed folders are cut from a large sheet.

The tabulation that follows shows the commonly used finished folder and booklet sizes, and the standard flat sheets of paper from which they are cut. The finished units can be printed in the multiples listed, on standard printing equipment. They fit into standard envelopes.

All but two of the printed units listed in the tabulation plan economically in the multiples 2, 4, 8, 16, and 32 pages.

With few exceptions, the 2, 4, 8, 16, and 32 page multiples of commonly used printed units fit onto printing presses, fit folding machines, and cut from standard paper sizes. With few exceptions, multiples of 6, 12, 20, 24, 28, and 40 pages c not fit either equipments or standard paper sizes.

Therefore a sound planning procedure is to strive to pl books and booklets in the multiples 8, 16, and 32 for the sa of economy. If the contents of the booklets cannot proper be fitted into those exact numbers of pages, the advice of t potential printer of the booklet should be sought.

Forest Ownership and Appraisal

The pattern of forest land ownership for the United Stat as a whole is a haphazard blend of Federal, State, and priva holdings which, singularly, is not dissimilar to the patte that has evolved over the centuries in the principal fore countries of Europe. There seem to be logical reasons f each type of ownership.

In European countries the practice of forestry has be benefited by a constructive competition between these grou

Of the 460 million acres of commercial forest land in th country, approximately 25% is publicly owned, 15% indu trially owned, and the balance, 60%, belongs to some fo million small owners holding less than 5000 acres each, a averaging less than 70 acres each. Since public land owne ship is concentrated heavily in the West, the pattern in t eleven western states is considerably out of balance with t whole. Here the Federal agencies own 60% of the sawtimb and to a considerable degree it is intermingled with the p vately owned mature stands.

Coordination in the handling of public timber and priva timber in the western states, therefore, is essential if forest i dustries, and communities dependent on them, are to prosp and develop to their full.

The important question before the people of the West co cerns the relationship of private and public forests. As I s it, we have a very few basic problems in this relationsh which call for action. Let us concentrate on them: In pa they are already the subject of policy declarations by t C.C.U.S. Other acute but relatively minor questions of t moment can and should be left to evolve further. Includ in this category are bitterly important local contests st ming from the present intense competition for raw mate We must not be diverted, either, by emotional, explosive, a largely imaginary charges against our business, illustrated the rash of articles, cartoons, innuendoes, which have a peared of late referring to "timber land grabs" and the alleg

	Size of printed unit	*Standard paper from which it cuts*	*Practical printing multiples*	*No. of pages cut from a sheet*	*The envelope that it fits into*
For enclosure with correspondence	$3^1/_4 \times 6^1/_4$	28 × 44	2, 4, 6, 8, 12, 16, 24, and 48 pages	96	Standard $6^3/_4$ Commercial Envelo
For small mailing booklet or to fit into pocket	$3^3/_4 \times 5^1/_8$	32 × 44	2, 4, 8, 16, 32, and 64 pages	128	Booklet Envelope No. 2
For mailing booklet	$4^1/_4 \times 5^3/_8$	35 × 45	2, 4, 8, 16, 32, and 64 pages	128	Booklet Envelope No. $2^1/_2$
For mailing booklet	$4^1/_2 \times 6$	25 × 38 38 × 50	2, 4, 8, 16, 32, and 64 pages	64 128	Booklet Envelope No. 3
For enclosure with correspondence or for separate mailing	$4 \times 9^1/_8$	38 × 50	2, 4, 6, 8, 12, 16, 24, and 48 pages	96	Standard No. 10 Corresponden Envelope Booklet Envelope No. 4
For mailing booklet	$5^1/_4 \times 7^5/_8$	32 × 44	2, 4, 8, 16, and 32 pages	64	Booklet Envelope No. 5
For mailing booklet	$5^1/_2 \times 8^1/_2$	35 × 45	2, 4, 8, 16, and 32 pages	64	Booklet Envelope No. 6
For mailing booklet	$6 \times 9^1/_8$	25 × 38 38 × 50	2, 4, 8, 16, and 32 pages	32 64	Booklet Envelope No. 7
Filing size recommended by Purchasing Agents Association	$7^3/_4 \times 10^5/_8$	32 × 44	2, 4, 8, and 16 pages	32	Booklet Envelope No. 8
Fits into standard letter file	$8^1/_2 \times 11$	35 × 45	2, 4, 8, and 16 pages	32	Booklet Envelope No. 9
For demonstration books	$9^1/_4 \times 12^1/_8$	38 × 50	2, 4, 8, and 16 pages	32	Booklet Envelope No. 10
For reprints of national magazine advertisements and for demonstration books	$10^3/_4 \times 13^3/_4$	28 × 44	2, 4, or 8 pages	16	.....

Appleton Twins For Dual Economy

A new Appleton supercalender to increase production. A modern Appleton rewinder for more speed. Team them up for *twice* the efficiency to cope with today's higher costs.

Appleton supercalender illustrated: 150″ 12 roll, has shaftless unwind arrangement and automatic roll handling from elevated storage platform. Operates at 1800 f.p.m.

Appleton rewinder illustrated: 150″ 2 drum, also ruggedly built, with low center of gravity to assure vibration-free operation. Operates at 3500 f.p.m.

APPLETON MACHINE COMPANY
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CUSTOM-BUILDERS OF PULP, PAPER & TEXTILE MACHINERY · CALENDERS · FINISHING ROLLS · REWINDERS · SCREENS · DECKERS

desire of the forest industry to "liquidate the national forests." This is unadulterated bunk.

Private forestry under the spur of necessity and opportunity is in a truly dynamic state. Within the last decade the forest industries have reached a notable degree of economic maturity and stability. It is evident in the permanent and elaborate plants that have been built—the extensive installations to utilize former left-over material of woods and mills—new product plants developed as a result of market extension work and research, and expanded activity in planting and seeding to insure that forest lands are kept busy growing trees.

Tree growing is profitable and practical on present economics and also promising for the long pull. Some such reasoning explains the 29 million acres of private land now in registered tree farms dedicated to growing forest crops permanently—the employment of 5600 foresters in private enterprises, a number greater than the total employed today in counterpart posts with Federal agencies—the purchase in late years of some $12^1/_2$ million acres of forest land by pulp and paper companies in the south alone, and some $3^1/_2$ million acres of land purchased by lumber firms since 1944. Land ownership is a means of permanency.

The purpose of the Forest Reserves, when established 50 years ago, was stated as the name implies, to hold the timber for eventual use when and as needed by industry. The Forest service was expected to assist industry into ways of good forest management. It earned such a reputation during the early decades of its existence by substantially aiding a very sick and impoverished Douglas-fir industry in many ways—among them holding back timber offerings, circulating economic information, and otherwise promoting the use of its lumber. Few lumbermen today are aware of any such past relationship.

Acquisition of Private Land by Public Agencies

About 20 years ago when the U. S. Forest Service as a national policy embarked on a program of acquisition of private forest land and regulation of cutting, it necessarily doomed the basis for confidence and good will with the forest industry. It did stimulate private owners to action and to that extent there is something to redeem in small part the folly and waste of effort that has ensued.

The excuse at hand was concern over future supplies of timber. It must be admitted that up until a decade or two ago, there was reason for concern if judgment was based only on the data which passed for fact on timber supply and new growth, the utilization practices of the time, and the inaction of operators due to their financial plight. Worry over the adequacy of timber supply has been chronic in some official quarters for a century.

Congress decided it needed facts. In 1928 the McSweeney-McNary Act authorized the Forest Service to make the first complete survey of the nation's timber resources. Twenty-five years have now elapsed, and in the last report of the Chief of the Forest Service for the year 1952, he stated that as yet 186 million acres, or approximately 30% of the acreage ordered inventoried, remained to be initially surveyed. As will be mentioned later, obsolescence has rendered valueless much of the report on the 70% of lands surveyed—obsolescence due to a complete revolution in utilization of forest material since the authorization of the survey, and even since 1940.

It seems incomprehensible that we have dawdled so with such an important basic matter as determining first what we have to work with. In this same span of 25 years, Finland, a country of $4^1/_2$ million people with a forest and area roughly the equivalent of the Douglas-fir belt of Washington, Oregon, and Northern California, has completed three such surveys at regularly spaced intervals and developed data of unquestioned acceptance. Further, little Finland had earlier made an important discovery that inducements are more effective than compulsion in government's relations with its citizens.

The Finnish government, in the mid-19th Century, debated a strict regulation of their lumber industry to preserve their diminishing forests, but the reasoning prevailed that the prices of stumpage and the products were permitted to reach a more profitable level, the land owners would be induced to pay increased attention to stimulating maximum growth of their forests and safeguarding the crop. We, in the United States, are learning that truth a century later.

The expansion of the National Forests through acquisition of private land by outright purchase or in various types of trades has been proclaimed a major necessity by official spokesmen of the Forest Service on numerous occasions in the last 20 or 30 years. Accomplishment has fallen far short of their announced and desired goal, due to a lack of funds and also the substantial opposition which was aroused. Some twenty million acres appear to have been added to the government's holdings of forest land in the last three decades, mostly in the East, but it is not believed that this total includes the acreage involved in special deals such as trade for cutting rights on Federal lands for private cut-over land. This has become a widespread device. It avoids some of the complications of competitive bidding on government timber and adds acreage to the Federal holdings without undue publicity.

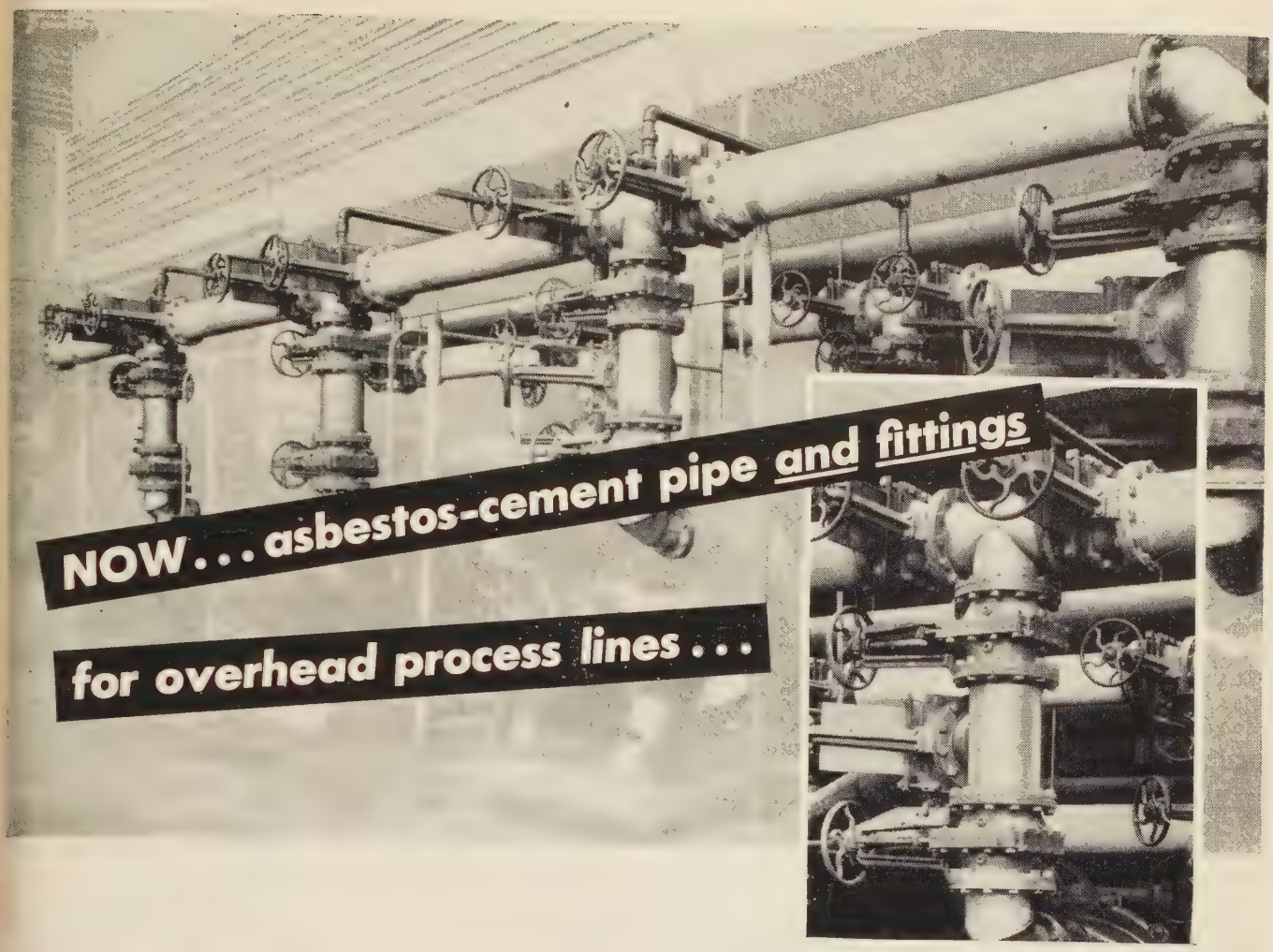
The report of the Chief of the Forest Service for 1 stated, "Practically all of the major problems of American Forestry center in or have grown out of private ownership"—he set the goal—"The acquisition of 134 million acres of forest land by Federal Government plus 90 million additional acres by various states." This suggested taking two-thirds of the total acreage in private lands.

Partly depression talk no doubt, but then in 1940 Secretary of Agriculture, Henry Wallace, added this comment in specific reference to the Pacific Northwest situation—"By all odds the most immediate and urgent forest problem in the Northwest is excessive private ownership. I give public acquisition of forest lands first place in a remedial program. We are not guessing about the situation at all. The most carefully controlled studies indicate that in the Northwest the Federal and state governments should acquire additional forest land that carries about 62 billion board feet of timber."

The Chief's Report for 1950 scaled down the amount of land still unacquired but believed primarily suitable for National Forest purposes, to an additional 35 million acres, this same figure was mentioned last year (1952) by the Assistant Chief as the acquisition called for under the Forest Service's long range policy, and he added, "The Forest Service sees no reason to depart from this program because of the present emergency."

There may be some logic in blocking out certain areas for efficient management either all private or all federal, but the continued yearning of a Federal Bureau for more land, land which must be assumed to be suitable for private operation, holds little comfort for those who believe that many needs of this country are and will continue to be—jobs and taxes, supplied by private enterprise.

The devotion that has been shown to this policy of acquisition, and the effort expended to effectuate a program of the magnitude indicated would obviously take more time and attention than needed in merely preparing official statements and reports thereon. The acquisition program and its companion-piece, the regulation of cutting on private lands by public authority, has dominated the thinking and doings of the U. S. Forest Service for 20 years, and has undoubtedly absorbed a healthy chunk of their congressional appropriations and other income over the years. Scanning the past budget requests won't supply any data as to the real amount. Even more costly, perhaps is the certainty that engrossment with acquisition and regulation necessarily caused neglect of other



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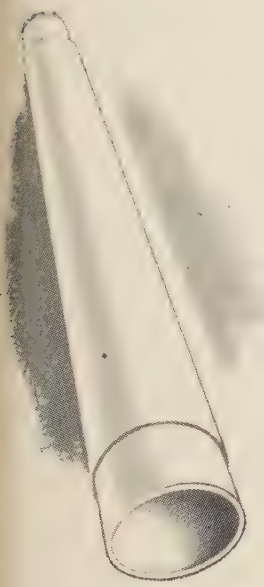

You can now obtain Transite* asbestos-cement Pressure Pipe with Transite-lined Streed Fittings for your overhead process systems. This permits the installation of high strength non-metallic pipe for handling raw and treated water, washed and unwashed pulps, stocks of all kinds, multi-stage bleaching systems (except direct chlorination) and certain mill wastes. There is no better way to provide clean pulp and stock than by handling it through Transite Pressure Pipe.

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Johns-Manville TRANSITE PRESSURE PIPE

functions directly related to the management of a vast acreage, and especially the marketing of its production. Forest road building is an example. In the several recent years of extremely active demand for forest products, it is conspicuous that the National Forests produced a pitifully small share of raw material. Even today it appears that production is about one half to two thirds of what is believed to be their proper capability. In the ten-year period 1942 to 1951 the National Forests harvested 56% of the allowable cut in the Douglas-fir region—Region No. 6. A similar percentage of production to allowable cut holds as well for Region No. 1—Idaho, and Region No. 5—California. Time has not permitted securing similar data for the other Regions of the West. It is well to remember that loss occurs even when trees are stored on the stump. When challenged on this point of undercutting, representatives of the Forest Service frequently retort with the excuse of lack of money and lack of personnel. Many competent observers believe a better solution of the problem would be a change of policy, with a re-allocation of effort and funds.

To provide a proper basis for cooperation it is desirable that the program of the Forest Service and other Federal Bureaus for large scale acquisition of private lands be stopped, and that change in policy be announced. Exceptions may be desirable where administrative units need blocking out. But this flexibility should work both ways and serve to benefit certain private units as well. The checking of Federal Land Acquisition is the subject of two Policy Declarations of the Chamber of Commerce of the United States.

The Basic Forest Survey

It is desirable that the national survey of forest resources, known as the Forest Survey, be reorganized on a cooperative basis with industry and states participating, to the end that reasonably complete and accurate data can be available in the minimum of time. As has been inferred earlier, the results from the survey to date have better served propaganda than any profound understanding of the state of our timber resources.

At the present rate of progress, some 8 to 9 years must elapse before all of the forest lands will have been initially inventoried. In the meantime, important areas will have been reappraised the second, third, and possibly fourth time. The effect of new growth, changes in standards of measurement, elimination of gross error, and other reasons not specified are illustrated in a recent recap covering 19 states, partially or completely surveyed since the 1945 reappraisal and including California and parts of Oregon and Washington, all heavily forested states.

By appraisal made in 1944 and prior years this acreage showed 676 billion board feet. By the latest appraisal in 1947 and later years the same acreage showed 894 billion board feet, or an increase of 218 billion board feet which amounts to 32%. This substantial increase in timber supply is after an average of 10 years of intensive logging.

Another most extreme example with which I am personally familiar is on a restricted area so accessible by a network of roads that it could have been cruised from a limousine. In all fairness, it should be understood that here the size of the error was enhanced by failure to appreciate the merchantable values of a tract of low-grade timber when ideally located for transportation and logging. It is the Fort Lewis Reservation in Washington State comprising approximately 125,000 acres. The appraisal of 1938 showed 35,600,000 board feet. Up until the present date 100 million feet of timber has been logged with profit to the Government and the operators. The last estimate of the Post Forester indicated that a stand of merchantable timber of 200 million B.M. still remains.

—by Corydon Wagner, vice-president, St. Paul and Tacoma Lumber Co.

New Raw Materials

Despite the world's growing demand for pulp and pa there can be no doubt that any conceivable increase in spective requirements can be met through utilization of po tial new sources of fiber-bearing plants ranging from com grasses to the most exotic trees, a publication of the Food Agriculture Organization indicates.

The view is expressed in an article on "Paper's New R Materials" in the March issue of *Unasylva*, a magazine p lished by FAO's Forestry Division. Copies are availabl FAO's New York Information Office, Room 372 at Headquarters. The article is based on material prepared the Intelligence Unit of the *London Economist*, on behal FAO, for incorporation into a report being prepared for United Nations Economic and Social Council.

The world's demand for pulp and paper, the article sta may rise from 3.5 to 5% annually over the next 10 to 15 y to reach from 45 to 50 million tons in the early 1960's. T compares with the 1950 supply of 33 million tons. "Un fibrous materials other than coniferous wood (softwoo are used, the paper industry may well be faced with the dan of outrunning its raw material resources.

The article expresses doubt that the increasing world mand for pulp and paper can be met by the main produc centers—that is, by North American and European indust using coniferous wood for paper.

There is a strong case, therefore, for increasing the sup of pulp and paper in underdeveloped countries by harness those of their fibrous resources from which production of p and paper is technically and economically feasible. S resources exist, as yet largely unused. They include bro leaved forests of great extent, millions of acres covered w fiber-yielding plants, and renewable agricultural residues av able in tonnages of stupendous sizes.

Although exploitation of such resources has not yet pro profitable, the article states, FAO has endeavored to sh that exploitation is frequently possible as well as desirable

The article sets out main conclusions:

1. Tropical bamboo cane, bagasse, straw, and vari other agricultural residues, consititute suitable raw mater for the manufacture of pulp and paper on industrial lines.

2. Provided that these potential sources of fiber are lized, there can be no doubt that the world's supply of pulp raw materials is plentiful, and even abundant to meet conceivable increase in the world's prospective requireme for pulp and paper.

3. A variety of well-established pulping processes is av able for the conversion of the heretofore unconventional materials.

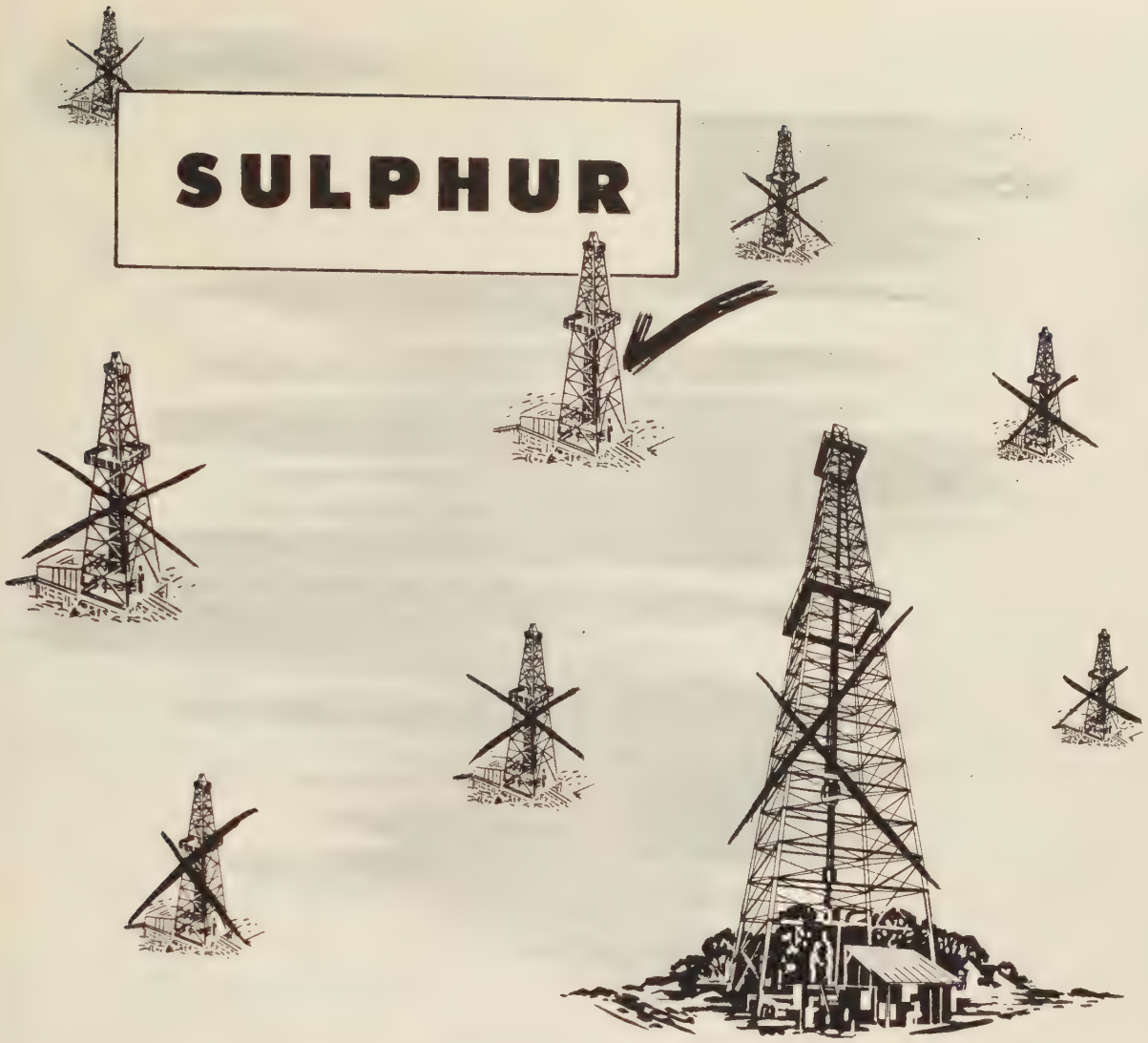
4. Generally speaking, chemicals, power, transportati and, above all, money, are more costly in underdevelo countries than in industrial areas, and it requires far m capital to establish an efficient pulp and paper mill in th countries than in North America or Scandinavia. The eff of these additional cost elements is, however, frequently off by the existence of cheaper raw materials and labor.

5. There is sufficient economic promise in the manu ture of paper from the newer raw materials to warrant thorough examination of a number of projects for setting new pulp and paper producing units in the tropics.

Magnesium Printing Plates

Basically, printing can be explained by a simple and fami example. Take a fingertip, lightly rub it on a little ink, th press it on a sheet of paper.

Reduced to basic terms, that's all there is to printin something to print from, a means of applying ink to the age, and a method of bringing together the image and paper. The complexities come in meeting the rigorous sta ards of quality and quantity set up for the industry tod



. . . producing Dome Sulphur is a *Chancey* business

"What is the cost?," is a constant and persistent query in the minds of managers whether operating a manufacturing plant or a mine.

When erecting a manufacturing plant the manager selects his location in regard to transportation of raw materials to the plant and distribution of the finished goods. On the other hand, a mine is found where nature has placed the ore and production must be in that locality.

In the case of production of sulphur by the Frasch Process, the ore lies 500 to 2500 feet below the earth's surface where nature made the underground formation. No engineer can see producing conditions.

Because of variations in formations, some sulphur mines produce efficiently and cheaply. Cost of production and marketing compared with the price determines whether the sulphur is commercially available.

Texas Gulf Sulphur Co.

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Sulphur Producing Units

- NEWGULF, TEXAS
- MOSS BLUFF, TEXAS
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and in producing staggering amounts of printed matter in an incredibly short time.

Regardless of the type of printing process used, the first step is to make a pattern of the material to be reproduced. The first record of the use of a pattern for printing is a book discovered in the Chinese province of Kansu bearing the inscription, "Printed on May 11, 868, by Wang Chieh, for free general distribution, in order in deep reverence to perpetuate the memory of his parents." This book was printed from engraved wood blocks.

Today the pattern or image can be made on several different kinds of material and in several forms—type, plate, block, or cylinder. The materials used include copper, zinc, magnesium, aluminum, plastic, paper, nickel, and steel. It was only about eight years ago that magnesium, the lightest metal of them all, was introduced to the printing industry on a commercial scale. Now it is a firmly established and highly respected member of the family of printing metals.

Just recently The Dow Chemical Co. has revealed the development of a new chemical method for making high quality magnesium printing plates much faster and more economically than by conventional methods. Let's see what the development means to the process of printing.

Although there are actually three basic methods of printing, lithography, letterpress, and gravure, most printing is done by the first two and are the ones where magnesium plates are an important factor.

Most modern lithography employs the "offset" process. The principle of lithography depends upon the fact that grease and water do not mix. The image to be printed is affixed to the plate in the form of a film of greasy ink which becomes the printing area. The spaces between, or nonprinting areas, are dampened with water. From this plate the image is transferred onto another rubber covered cylinder from which it is "offset" onto the paper. The offset press has separate rollers for ink and for water, so that each time the rubber blanketed cylinder turns around the greasy ink is replenished and the nonprinting areas are dampened so that ink does not adhere to those areas. The grease image on the printing plate is applied photographically.

Letterpress printing, on the other hand, is done from "relief" printing surfaces. The elements to be printed stand up above the rest of the plate surface, while the nonprinting areas do not come into contact with the paper. There many ways for lowering these nonprinting surfaces, the c generally used being etching with an acid or cutting and graving by hand or machine.

Because magnesium can be chemically etched so easily speedily it is proving its worth as an engraving metal, esp ally for printing labels, cartons and business forms. Now l get back to the new chemical method for making plates viously referred to, for it is in the etching process that the provements have been made.

The developments consist of the application of a uni etching solution to a magnesium alloy plate in a speci designed machine. Plates prepared by the new process etched cleanly and sharply in as little as one tenth the t required by present means.

Now, just what does this mean to the printing indust Simply that all printing plates made by photoengravin that is, fixing the image to the plate by photographic mean can be made at a competitive cost with those produced other methods. Processes employing photoengraved pla are advantageous because they are much faster and m efficient.

Dow research men feel that the etching development profitably be applied to several printing processes, some them new. One is the "dry offset" or photoengraved off which relies on an etched photoengraved relief plate inst of the type depending upon chemical methods for produc a printing surface.

The letterpress printers will be especially interested in new etching process where another new development printing, phototypesetting, is employed. A phototypesett machine closely resembles a linotype machine except that lines of type are produced on a photographic film instead being cast from metal. The film is then reproduced on pri ing plates by regular photoengraving methods.

Pulp and Paper Developments

Table I below gives a list of pulp and paper mills facilities that were planned, under construction, or comp during 1952. Table II gives important pulp and paper p ess and engineering developments announced or commer ized during the past two years.

Table I. Pulp and Paper Mill Expansion—1952

Firm	*Location*	*Dollars*	*Products*	*Job status and remarks*
Bowaters Southern	Calhoun, Tenn.	51,000,000	Newsprint	Construction scheduled for completion e '54. Capacity: 50,000 tons kraft p and 125,000 tons newsprint per year.
East Texas Pulp & Paper	Silsbee, Tex.	2,000,000	Paper, pulp	Construction scheduled for completion '54. 90,000 tons bleached sulphate p and paper board per year.
Great Northern Paper	Millinocket, Me.	....	Newsprint	Expansion planned (as of May, '53). make newsprint from hardwood.
Hollingsworth and Whitney	Mobile, Ala.	....	Bleached paper	Increase of 150 tons per day planned of March, '53).
International Paper	Camden, Ark.	2,000,000	Paper	Expansion planned. Current capacity: tons per day.
International Paper	Tonawanda, N. Y.	300,000	Bleached soda pulp	Certificate of necessity granted.
New York and Pennsylvania	Johnsonburg, Pa.	2,500,000	Book and magazine paper	Certificate of necessity granted.
New York and Pennsylvania	Lock Haven, Pa.	2,000,000	Paper and bleached wood pulp	Certificate of necessity granted.
Puget Sound Pulp and Timber, American Viscose	Ward Cove, Alaska	46,000,000	Pulp	Planned. To use magnesia-base pulpin
Rayonier	Brunswick, Ga.	24,000,000	White wood pulp	Certificate of necessity granted.
Rayonier	Jesup, Ga.	25,000,000	Chemical cellulose	Under construction.
Rhinelander Paper	Rhinelander, Wis.	700,000	Bleached semichemical pulp	Certificate of necessity granted.
St. Regis Paper	Jacksonville, Fla.	....	Kraft paper	On stream early '53. 100,000 tons per y $4.5 million expansion planned to completed mid '54.
Valentine Pulp & Paper	Lockport, La.	2,600,000	Pulp, newsprint	Scheduled for operation late '53. 50 t pulp per day. New process to use su cane bagasse.
West Virginia Pulp & Paper	Charleston, S. C.	3,000,000	Semichemical pulp	Increase of 200 tons per day planned (a March, '53).

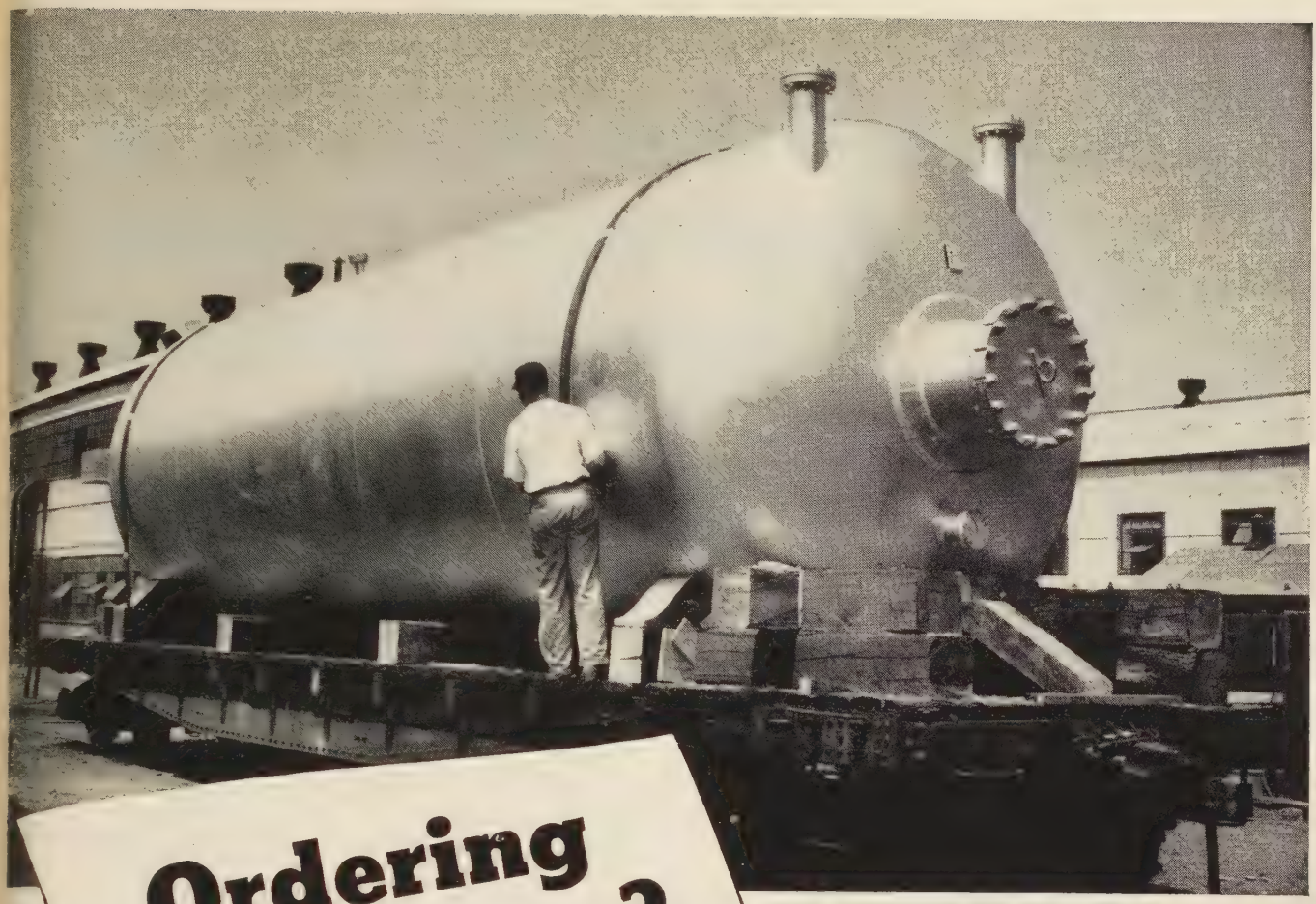

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Table II. New Developments in Pulp and Paper

Product	*Process*	*User and location*	*Features*	*Status and remarks*
Battery separators	Wood fibrization	Evans Products Co., Bay, Ore.	Wood is fiberized and reformed into finished separators.	In production.
Black liquor recovery	Combustion	Combustion Engineering, Inc., Chicago, Ill.	Rearrangement of heating surfaces in superheater cuts slag formation, spray gun delivers superheated feed which gives partial flash drying.	. . . . .
Cellulose	From banana stalks	Cia. de Cellulise Banex, Brazil	. . . . .	Process developed in Brit known as Polpex.
Crepe paper	. . . . .	General Electric Co., Pittsfield, Mass.	Made of kraft and manila fibers, has triple the strength of previous industrial crepe paper.	Used for cable wrapping.
Hardboard	Resin-binder	Anacortes Veneer, Inc., Anacortes, Wash.	Douglas-fir veneer waste is chipped, steamed, cooked, ground, mixed with 1–3% resin, felted, pressed, and cured, all in semi-dry condition.	$1-million automatic plant t ing out 90,000 sq. ft. 1/ hardboard per day with men.
Kraft corrugating medium	Semichemical	Camp Mfg. Co., Franklin, Va.	Deaeration and presoaking of chips used in continuous process.	Used in 50 ton/day plant.
Kraft paper	Kraft	. . . . .	Made from mixture of southern pine waste wood and normal pine pulp.	Developed by Herty Fou tion, Savanah, Ga.
Kraft pulp	Odor control	Nekoosa-Edwards Paper Co., Nekoosa, Wis.	Chemical agent added to digester masks odors throughout pulping and recovery systems.	Developed by du Pont, u on trial at Nekoosa.
Kraft pulp	Odor control	Weyerhaeuser Timber Co., Springfield, Ore.	Odorous sulphide-containing vapors from kraft cooking liquors are oxidized when liquor passes down through a tower co-current with air.	Process treats 300 g.p.m. bl liquor with 3 g./l. sulphi using 10 c.f.m. air/gal. liq
Lignosol	Concentration	Lignosol Chemicals, Ltd., Quebec City, Que.	Concentrated lignin liquor or powder made from waste sulphite liquor.	
Newsprint	Alkaline extraction of bagasse	Valentine Pulp & Paper Co., Lockport, La.	First commercial mill for newsprint from bagasse will use rapid processing cycle, including prehydrolysis followed by alkaline extraction and light but conventional refining.	Spending $2.6 million for ton/day mill. Rayon C of the Philippines plans make dissolving pulp f bagasse.
Newsprint	Chemigroundwood	Great Northern Paper Co., East Millinocket, Me.	First use of hardwood for newsprint in North America. Process involves pretreatment of hardwood in pressure vessels, followed by grinding. Product is mixed with softwood pulp.	Experimental work compl Great Northern is expand output, including facilities new process.
Newsprint	Papermaking	Beloit Iron Works, Beloit, Wis.	Transfers fragile web from fourdrinier wire to press section, permits higher running speeds.	
Papermaking	Press roll load control	Gibraltar Corrugated Paper, North Bergen, N. J.	Strain-gage load meter measures roll loading within 0.25%.	Installed and operating.
Papermaking	Weight control	Strathmore Paper Co., West Springfield, Mass.	Absorption beta gage assures uniformity, holds sheet weight to less than 3% variation.	Installed and operating.
Pulp (bleached)	Chlorine dioxide	Riegel Carolina Corp., Acme, N. C.	Plant manufacturers own chlorine dioxide from sulphuric acid, sodium chlorate, methanol vapor and air. Water solution at 160° F. is used as last bleaching stage for pulp after hypochlorite bleaching.	Plant built and process veloped by Solvay Proc Div., Allied Chemical & D Corp.
Soda pulp	Cold caustic digestion	Green Bay Pulp & Paper Co., Green Bay, Wis.	Chips soaked 2–3 hr. in 2.5% NaOH at room temp., drained, steamed, pulped in double-disk refiner. Cycle requires 4 hr. Used as 1% stock.	Being used as 25–60% mi with semichemical pulp making corrugated.
Sulphate pulp	Continuous	. . . . .	Continuous process eliminates prehydrolysis. Pulp is satisfactory for viscose and acetate manufacture.	Developed at University Florida.
Sulphite pulp	Evaporation	. . . . .	Lime in liquor crystallizes on bed of lime salts eliminating fouling.	Built by Struthers-Wells, tri conducted early 1952.
Sulphite pulp	Magnesia base	Weyerhaeuser Timber Co. Longview, Wash.	Process substitutes MgO for lime. Big advantage is nonpollution of streams—all waste liquors are burned for power generation.	Now operating commercially 300 ton/day scale. Proc will be used also by Ketchik Pulp Co. in new Alask mill.
Sulphite pulp	Soda-base pulping	Nekoosa-Edwards Paper Co., Port Edwards, Wis.	Process substitutes caustic soda for limestone in making sulphite cooking liquor. This is expected to make cooking liquor recoverable and so cure pollution problem.	Developed by Western Preci tation Co. About 500 tons pulp has been made by t process but critical evalu tion of recovery process v be needed before a decis to go ahead.

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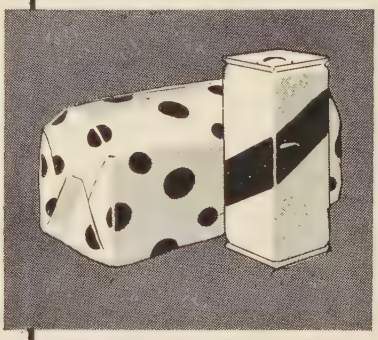

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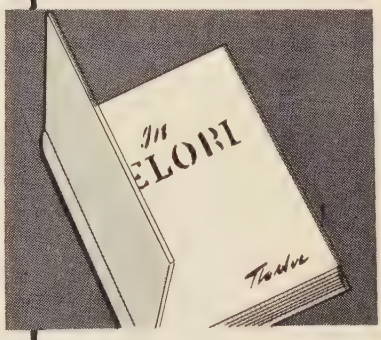

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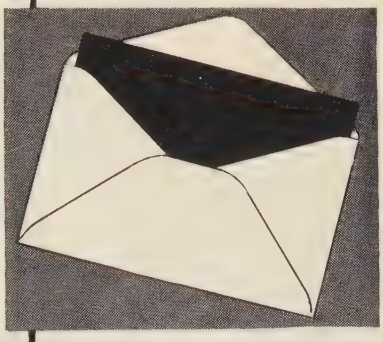


FOR OPACITY

"Ti-Pure" eliminates show-through—especially important in lighter-weight papers for envelope stock, stationery and waxed board. Saves user money on mailing costs.

Table II. New Developments in Pulp and Paper (*Continued*)

Products	*Process*	*User and location*	*Features*	*Status and remarks*
Sulphite pulp	Waste disposal	.....	Calcium-base waste sulphite liquor burned without auxiliary fuel.	Developed at Washington Sta College.
Wood panelboard	Continuous	Bartrev, Ltd., Colchester, England	Resin-treated wood particles are fed in continuous carpet on stainless steel belt, bonded by heat and pressure, emerge as continuous length of board.	Available in United Stat through Aries Fibreboa Corp., New York.
Wood pulp	Va-Purge	Various	Preliminary steaming and purging step gives faster, more complete liquor penetration of wood chips, shortens cooking time, increases yield and uniformity.	Undergoing trials in a numb of mills.

—from *Chemical Engineering*, January, 1954.

West Virginia

C. R. Chamberlain, manager of the Lynchburg, Va., wood office of West Virginia Pulp and Paper Co., has assumed the responsibility for the operation of the wood department of the Covington, Va., mill. He replaces G. L. Knapton, who has retired. The Lynchburg wood office is being closed July 1, after which time Mr. Chamberlain will make his headquarters in Covington.

Rhinelander

For the fourth time since building its first factory in 1948 to make vitamin-rich torula yeast for animal and human nutrition by processing spent liquor from Rhinelander Paper Co.'s sulphite pulp mill, Lake States Yeast Corp. has substantially increased its plant capacity and has accordingly cut the flow of spent sulphite liquor into the stream.

This latest production step-up came through adding a modern large-capacity drier to the yeast factory's equipment, thus opening up a production bottleneck. As originally engineered six years ago, a single drier handled the plant's entire output of yeast and had plenty of unused capacity to spare. Since then repeated process improvements, increased equipment, and building additions in other departments have boosted Lake States yeast-making capacity beyond what the old drying room could take care of.

The new unit permits the plant to process 10% more spent sulphite liquor than before, and the over-all effectiveness of the yeast process in abating stream pollution goes up by the same amount. With this latest addition, Rhinelander Paper Co. and its by-products subsidiary own and operate liquor-processing plants that cost about $1,000,000. This is one of the largest investments anywhere in the world for reducing sulphite stream pollution, and has brought proportionately major improvement to the Wisconsin River below the installation.

Sealright

The Sealright Co., Inc., has installed its fourth Manhasset flexographic press, a model No. 336 "APS," made by Manhasset Machine Co., Mineola, N. Y.

A three-color press designed to handle mill rolls of 48 in. diameter and 36 in. width, the machine is being used in Sealright's Kansas City, Mo., plant to print paper cups, containers, and other similar products. The press has a maximum rated speed of 600 f.p.m. It is equipped with interchangeable nonsplash fountains and special cylinder bearings that permit quick and easy changeover of colors and copy to minimize down time between jobs.

Western Containers

A new corporation known as Western Containers, Inc., has been formed to operate a corrugated box business in the city of Lockport, N. Y. The new company will purchase the physical properties of Western New York Container Corp. and Lockport Paper Products, Inc., from their stockholders, and will be affiliated with The Ohio Boxboard Co. of Rittma Ohio. A. W. Sterritt, president of Western New Yo Container Corp., who will serve as president of Weste Containers, Inc., states that there will be no significa changes in personnel or policies.

Union Bag

An all-time high in production records was set April 2 Union Bag when the six giant paper and board machin turned out 2163 tons of finished product during the 24-ho period—a little over a ton and a half a minute.

Rayonier

An addition to the woodmill at the Port Angeles Divisio of Rayonier Inc. is being constructed at a cost in excess of $ million to effect substantial savings in wood for chemic cellulose production.

This latest investment in woodmill facilities is part Rayonier's conservation program calling for constant im provements in wood handling facilities to obtain maximu economic use from both public and private forests. Th woodmill addition is another step toward obtaining mo chemical cellulose from any given quantity of timber. Suc new wood savings will materially extend the timber resour available to the three Rayonier plants in the Northwes The company controls 382,750 acres of timberland in Nort west Washington and 462,550 acres in Florida and Georgia.

A new two-story 5700-sq. ft. steel building is being erecte to house a new ring type hydraulic barker capable of handlin logs up to 36 in. in diameter on a continuous basis. As th log passes through the ring three high-pressure jets deliverin water at 1400 p.s.i. remove the bark. The new barker re places older mechanical bark removing equipment an supplements existing hydraulic debarking capacity.

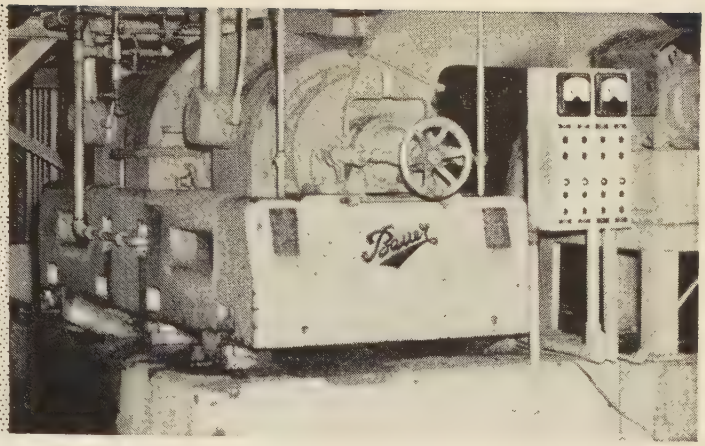
The woodmill addition will also include a new whole lo chipper which reduces a 36-in. diameter, 24-ft. long log int uniform chips of the desired size in 14 seconds.

The new facilities, including a new crane capable of liftin a railroad car of logs, also offer important time savings i primary operations in chemical cellulose production.

Following is a list of equipment suppliers, contractors, an consulting engineers contributing to the project:

Suppliers

Chipper—D. J. Murray Manufacturing Co., Wausau, Wis.
All motors, except barker pumps and chipper motor—Allis Chalmers Mfg. Co., Milwaukee, Wis.
Barker pump motor, chipper motor, substation, control desk and cubicles—Westinghouse Electric Corp.
Transfers, roll cases, belt and refuse conveyors—Sumner Iro Works, Everett, Wash.
Bundle deck and chipper bridge cranes—Berger Engineering Co., Seattle, Wash.
Steel chip silo—Beall Pipe and Tank Corp., Portland, Ore.
Rotary plate feeder for chip silo—James Brinkley Co., Seattle Wash.
Gear drives—Western Gear Works, Seattle, Wash.
Air compressor—Ingersoll-Rand Co.
Barker—Hansel Engineering Co., Seattle, Wash.
Barker pump—Byron Jackson Co., Los Angeles, Calif.



You are right if your choice of refiner is based on performance

The proof of actual results is the reason for the growing usage of Bauer Disc Refiners

Bauer Double Disc Refiners produce unique fiberizing and dispersing results through brushing and rolling manipulations combined with vigorous agitation and turbulence. The effects are especially important in the refining of short fibered pulps when a paper or board of improved appearance and greater strength is required.

Bauer

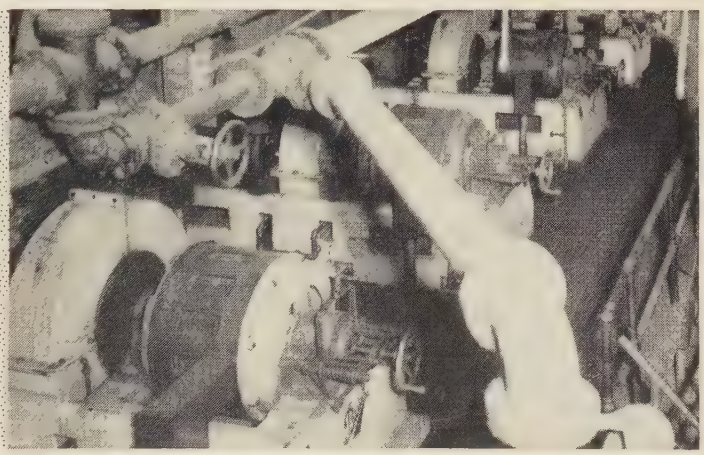
The extensive line of Bauer Single Disc Refiners has wide application for preliminary size reduction as well as final treatment of pulp stocks. Each job is an exactly engineered project in itself. There is no one refiner to do all jobs best.

We'll be glad to show you mill samples and engineering data as evidence of the work done by all Bauer Disc Refiners. In case you wish to try new materials, the Fiber Products Laboratory is at your service for test runs on commercial machines.

You are invited to communicate with us or confer with our sales engineers.

THE BAUER BROS. CO.

1715 SHERIDAN AVENUE • SPRINGFIELD, OHIO



Contractors

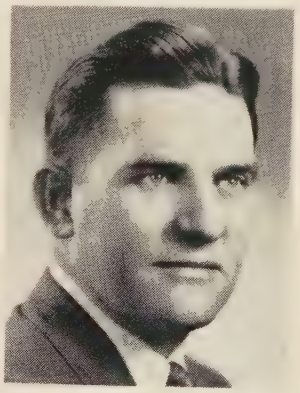
Concrete and carpenter work—Howard S. Wright Co., Seattle, Wash.
Structural steel—Leckenby Structural Steel Co., Seattle, Wash.
Machinery installation and piping—Bumstead-Woolford Co., Seattle, Wash.
Excavation, pile driving, and fill—Owens Bros. Engineering & Construction Co., Port Angeles, Wash.
Sprinkler system—Viking Automatic Sprinkler Co., Seattle, Wash.
Electrical installation—Olympic Electric Co., Port Angeles, Wash.
Masonry—George Mangano, Port Angeles, Wash.
Plumbing—Harold Hibbs Plumbing & Heating Co., Port Angeles, Wash.
Transite roofing and siding—Del Guzzi Bros., Port Angeles, Wash.
Built-up roofing—Alleman Mill and Supply Co., Port Angeles, Wash.

Consulting Engineers

Stevenson and Rubens, Seattle, Wash.

Personal Products

Robert D. Glidden has been appointed director of paper operations of Personal Products Corp. and vice-president of Stonebridge Paper Corp. Mr. Glidden, who is also a member of the board of directors of Personal Products Corp., will be in charge of the company's paper mills at New Brunswick, N. J., Milltown, N. J., and the Stonebridge Paper Corp., Wilmington, Ill.



R. D. Glidden, Personal Products Corp.

Marketing

In a recent talk before a meeting of distributors and their guests from the manufacturing end of the paper industry, John R. Kimberly, president of Kimberly-Clark Corp., stressed the marketing task which lies ahead for the industry—for supplier and wholesaler alike.

Using personal consumption expenditures as the basis for evaluating the marketing job to be done, Mr. Kimberly made the following points: $17 billion was spent in 1935 by consumers in excess of expenditures for necessities; $136 billion in 1950 and, if the present pattern holds, more than $200 billion may be spent in 1960. An analysis of personal consumption expenditures shows that in 1935, 70% of the total went for *needs* (food, clothing, shelter), whereas in 1950 only 31% fitted into this category. The market for *wants* had obviously expanded substantially during this 15-year period. Pointing out that it is not difficult to sell food to a hungry man with money in his pocket, Mr. Kimberly said "the combined efforts of advertising, promotion, and selling are needed to compete for the balance of the dollars" the consumer is willing to spend.

Mr. Kimberly said that the paper merchants must do their part in assessing how they expect to meet the marketing challenge of the future. The records show that wholesalers of manufactured goods have not kept pace over the years with other types of wholesalers. The speaker then pointed out that as the volume of purchases made by his customers increases, the manufacturer spends substantial sums to aid him in making decisions regarding the expansion of production facilities and in acquainting the customers with the product line. "I know many of you are doing the same," Mr. Kimberly continued, "but I believe it is well to look carefully at our business in the light of changing conditions and to ask ourselves these questions: (1) Are we investigating our lines of merchandise? (2) If items are decreasing in volume, do we know the reasons why? (3) Are we studying our orders from the standpoir of profitability and economy in handling? (4) Have w studied modern methods of inventory controls, warehousin and materials handling? (5) Are we making a real attem through market studies to anticipate our customers' wan and aiding our suppliers with sound information? (6) A we using advertising and promotion helps available to us t the best advantage? (7) Are we teaching our salesmen ho to do the most effective job of merchandising this advertising (8) Are there areas where an advertising program of our ow will be of real benefit? (9) Are we strengthening our sal force through better selection and training? (10) Above al are we performing a real wholesaling function that adds a plu value to the product when it reaches the customer?"

Turning his talk to the manufacturing end of the pape business and the tremendous increase in capital investmen required to meet the increased demand for products, M Kimberly noted that it has become increasingly important t "make as careful a projection of the future demand" a possible. He mentioned increasing costs; changes in prod ucts and end uses and emphasized customer buying habits— particularly the question of whether habit or impulse buyin is being replaced to a degree by more rational planning This type of marketing study is going on intensively in mor and more American businesses every year. It was ex plained that efficient management must meet the challeng which is ahead of everyone who is marketing a consumer commercial, or industrial product. Sales organizations mus expand their market research units and improve their adver tising and sales promotion, sales training, new product de velopment, merchandising, and laboratories for produc testing and consumer acceptance.

During his talk, Mr. Kimberly noted the distinction be tween *value* and *price*, saying "Too often we think of value as price.". . . His belief he said is that "value of a produc is made up of quality, service, and price."

Mr. Kimberly said that in addition to knowing the quality required for the particular end use intended, the manufacture must know the type and potential number of customers an their locations; their buying habits; their present needs and their plans for future requirements. This latter, h said, is the job of market research. Keeping their name an product identity before present customers and acquaintin potential customers with their products is the job of adver tising. To sales promotion is attributed the responsibility fo focusing attention of everyone in the distribution system as well as the customer, on the product. We must have intelligent adequately trained men to represent our companies in the field. They must know their own products and also their customers' businesses and requirements. They must sell the customer what he really needs and what will be of greatest value to him, and this is a far cry from order taking.

In conclusion, Mr. Kimberly emphasized his belief that the paper industry has a bright future and warned that in whatever phase we may operate we must be as aware of our responsibilities as we are of our opportunities.

Donnacona

Control of the Donnacona Paper Co. by Howard Smith Paper Mills Ltd., through stock purchase, occurred in 1949. By the end of 1951, the company had acquired 65% of the outstanding stock, and, by means of an exchange of shares, had increased this proportion to 96.5% at the end of 1953. This acquisition consisted of a paper mill with an annual capacity of 105,000 tons of newsprint, a sulphite pulp mill making 50,000 tons of unbleached sulphite pulp, a board mill making 100,000,000 sq. ft. of insulating and sheathing board, and a well-developed woodlands of some 1721 sq. miles.

The origin of the company dates back to 1912, when it was organized to acquire and develop the water power and timberlands then owned by the late George M. McKee. The

A Progress Report to the Paper Industry

. . . A factual statement of the impressive progress of the Solvay method of producing and using chlorine dioxide for pulp bleaching

About a year ago, Solvay Process Division announced that a new system for producing and using chlorine dioxide as a bleaching agent had been in successful, commercial operation in one of the country's newer paper mills for more than one year. We also reported that operational results had exceeded expectations.

Since that time, this subject has been widely discussed throughout the industry. The past year has seen wide acceptance and rapid expansion in the adoption of this new bleaching system. With the thought of keeping you up to date, we present the following progress report:

GROWTH

Four major paper companies are now using the Solvay system for producing and using chlorine dioxide, with four additional plants under construction and due to go into operation within the year. The original plant installation has now been in continuous operation for two years.

OUTPUT

Over 1400 tons of pulp are currently being bleached each day by the plants now in operation. The total output is expected to exceed 2600 tons per day by the end of the year, when the plants under construction get into production.

GRADES OF PULP

Three grades of paper-making pulp—kraft, sulphite and neutral sulphite semi-chemical—are currently being bleached with chlorine dioxide produced by the Solvay method.

Before the end of 1954, dissolving grades of pulp (both prehydrolysis kraft and sulphite) for the production of synthetic fibres and cellophane will be in regular production.

QUALITY IMPROVEMENT

The combination of chlorine dioxide and the Solvay chlorine dioxide bleaching process has established new standards of quality, dependability and color permanency.

- Color brightness, running from G.E. 88 to 94, is regularly obtained on paper-making grades of kraft and sulphite pulp *without loss of strength.*
- The product is cleaner. Virtual elimination of wood dirt has resulted in a corresponding reduction in shives.
- Greater yield means increased production.

In addition, it supplies the high quality and the control of viscosity which are so important in the dissolving grades of pulp.

The Solvay chlorine dioxide bleaching process is operated in a specially developed bleach cell unit designed by Improved Machinery Corporation. The chlorine dioxide manufacturing unit and the flow bleaching process have been, and will continue to be, available to the paper industry on a non-exclusive contract and on a royalty-free basis. In addition, Solvay's Technical Service is available without charge, both during the design stages and the start-up and training periods.

If you would like to have further information regarding the application of this process in connection with a specific phase of your operations, write to us in confidence, giving the details. We will be glad to supply further information.

SOLVAY

SOLVAY PROCESS DIVISION

Allied Chemical

ALLIED CHEMICAL & DYE CORPORATION

61 Broadway, New York 6, N. Y.

site was cleared that year and construction of the mill and bower dam began in the spring of 1913, with the first paper peing made on Feb. 13, 1914. It is perhaps interesting to note here briefly the factors which influenced the organization of this company. First, many newsprint manufacturers in the United States realized in the early 1900's that their expanding use of pulpwood would eventually deplete their resources. They thus began to import increasing amounts of wood from Canada. This soon reached alarming proportions, and the Quebec Provincial Government, then under the leadership of Sir Lomer Gouin, prohibited the export of pulpwood. Second, newsprint could enter the United States duty free. Other factors also played their part, but these two are chiefly responsible for the large expansion of the newsprint industry from 1911 onwards.

Donnacona was no stranger to papermaking. As early as 1817, a Mr. Jackson had built a small mill for making handmade paper for the seigneur, George Allsopp. It was known as the Jacartier Mill, but was shut down in 1827. Five years later, the firm of Miller, McDonald & Logan leased it for a period of four years, and the lease seems to have been extended into the 1850's, when a new lessee, Peter Ford, took over. He installed a small machine for the manufacture of strawboard and coarse writing paper, but in 1857, the mill burned and Peter Ford moved to Trenton, Ont.

In the meantime, other members of the large Ford family had built or acquired mills at Portneuf, some 8 miles west of Jacques Cartier. After several failures and sales, the firm of J. Ford & Co. Ltd., was formed in 1886 and Peter, a brother of Joseph, came back from Trenton and built a new mill called the Portneauf Paper Co. The old McDonald & Logan Mill, where the Fords had got their start had passed into the hands of a Louis Dupont, who, in 1890, purchased a mill on the Jacques Cartier River at Pont Rouge, which had been built in 1871. Dupont ran the mill until 1894, then a James Reid took over, to be followed in 1897 by the formation of the Jacques Cartier Pulp and Paper Co. Both this mill and its riparian rights were purchased by Donnacona in 1916.

The locale of all these mills with their family interconnections, is at the point where the mighty St. Lawrence, in its northeastern flow, begins to cut through the Laurentian shield. Sparkling rivers, fed by springs and lakes nestling among the rolling and forested mountains, carry the logs and drive the turbines for direct or electric power. In years past, the Jacques Cartier River carved its way through the high escarpment on the shores of the St. Lawrence and formed a flat delta at its mouth. Here the early trappers and traders were wont to gather or stop over on their journeys in the early 1600's. Nearby, in 1759, the French built a stockade fort to which their army retired after Wolfe's victory at Quebec, and here they wintered preparing for their ill-fated attempt to recapture Quebec the following Spring. They nearly succeeded, but the arrival of a relief fleet caused them to retire to Fort Jacques Cartier, where they left a small garrison. This garrison was later overwhelmed, but had put up such a good fight, they were accorded the honors of war and allowed to march forth with their arms and baggage. This was the last stronghold to be captured by force, the rest of the country deciding to bow to the inevitable.

The difficulty of bridging and of maintaining bridges against the rushing spring torrents of the Jacques Cartier River caused the main Quebec-Montreal highway to be located several miles inland. This left the Jacques Cartier settlement in an outpost position except for river transport. For many years, then, it served as a very local center for the ever-present grist and saw mills usually owned by the seigneur. When in the late 1770's George Allsopp, who had held various government posts, purchased the fiefs of Jacques Cartier and d'Auteuil, his enthusiasm and industry soon brought more activity to this backward settlement. Sawmills were erected to exploit the large pine then abounding along the Jacques Cartier River; new grist and flour mills were set up. H son, Robert, took over his properties after his death, and was during Robert's regime that the first paper mill w built. Others were attracted to the site and a rock s grinding mill and a bake shop for sailors' biscuits installe About 1866, Arthur Sewell bought the property which h become known as the "Fonds Jacques Cartier." Fires a disasters took their toll and eventually, Charles Sewell, w had inherited the property, sold it to John Foreman, in 19 But the old place was tired. The prime saw lumber had be cut off, more modern mills could grind better and cheap and the character of the district was no longer one of se containment. The old days were over, and it was time f modern industry to move in. This it did in 1912, when Ge McKee purchased the property and water power rights fr Mr. Foreman. It was the dawning of a new era, and t pioneers whose graves dotted the countryside could well a prove how their beloved Jacques Cartier would again provi the power and the means to a bigger and more useful purpo in the development of our country.

Industrial History

When completed in 1914, the original mill containing o 160 in. machine had a daily capacity of 50 tons of newsprin all of which was shipped under contract to the *New Yo Times*. Since newsprint is made from a mixture of groun wood and sulphite pulps, facilities for their manufacture we provided, and the pulp mills had a daily capacity of seven five tons of groundwood and thirty tons of sulphite. A lar dam was constructed a half-mile up the Jacques Carti River, the water from which generated 6000 horsepow Part of this was used for electricity for power and lightin in the mill and to supply the town. The balance was use directly to drive the wood grinders.

The proximity of the dam enabled it to be used as a l storage pond for river-driven wood, and, because of elevatio logs could be cut and barked at the pond and fed by gravit flume direct to the woodroom, or to the large pulpwood pil which supplied the mill in Winter.

In February of 1916, a second paper machine of the sa width was added, which doubled the capacity. This ca into operation in November of that year. At this same tim additional equipment was installed in the groundwood m and other additions planned. Since power requiremen were fast outgrowing the capacity of the original installatio the company purchased the plant and power rights of th Jacques Cartier Pulp and Paper Co. some 10 miles up riv at Pont Rouge. The output of three small grinders w used for some 10 years, but it is now known as the Ma Dougall Falls Power Plant and produces about 3600 hp., fro its two generators, which is fed to the main mills on the co pany's own transmission line.

During the 1914 to 1926 period the market for newsprin continued to expand with but few minor setbacks. Cond tions looked so favorable for the future that expansion seeme inevitable, thus the management was continuously unde taking new projects. By 1926, another large paper machin had been installed, bringing paper capacity up to 68,000 to from the original 15,000 sulphite pulp capacity had bee increased from 9500 to 19,000 tons, and groundwood pul from 18,000 to 64,000 tons. To supply the increased d mand for pulpwood, the company expanded its Jacques Cartie limits from the original 282 to 748 sq. miles, and made further purchase of 205 sq. miles from the Iberville Lumbe Co. Some 93 sq. miles were later returned to the Departmen of Lands and Forests for colonization purposes, thus the tot in 1926 stood at 860 sq. miles.

Major Changes 1926 to 1936

This 10-year period saw many changes, both in th organization of the company and its operations. Pric

Dicalite

is your answer to both

The question, usually, is not what to do with white water, but what to do *about* it. Some mills have the problem of stream pollution; others the problem of water supply. Fortunately, Dicalite filtration answers both.

DISPOSAL If re-cycling is not required, filtration with Dicalite Filteraids yields a brilliantly clear effluent with no suspended solids to cause pollution.

RECLAMATION Filtered white water can be re-cycled, using a partially or entirely closed system. Dicalite filteraids remove all solids to give brilliantly clear water which is equal – often superior – to fresh water for most systems. Only a small percentage of fresh make-up water is needed daily. Water is saved and no disposal system is required.

IN EITHER CASE, you get still another advantage; practically 100% recovery of furnish components such as fibers, fillers and filteraid – all of which can be re-used to lower your furnish costs. Let us send you complete information on the many paper mill uses of

Dependable GREAT LAKES *Dicalite*® DIATOMACEOUS MATERIALS

DICALITE DIVISION, GREAT LAKES CARBON CORPORATION, 612 SOUTH FLOWER ST., LOS ANGELES 17, CALIFORNIA

Brothers and Co. acquired control of the company in 1927, and early in 1928, the old Ontario charter was superseded by a Province of Quebec charter coincident with a reorganization of the company's securities. Soon after the new owners had taken over, they were faced with the 1929 depression, and in an effort to consolidate their own position, relinquished their control in 1932, and Donnacona was once more an independent entity.

Some time prior to the 1929 crash, the company had been planning the installation of equipment for the manufacture of the insulating board which was then becoming popular in many types of construction. These plans came to fruition in 1930 when the new board mill came into operation with a capacity of 45,000,000 sq. ft. annually, but the market was anything but good, and it was a struggle to keep it operating profitably. One of the adverse factors was the need for an entirely different marketing and merchandising setup, with a sales force which could cover the wholesale and retail building supply dealers. This problem was finally solved in 1932 by appointing the Alexander Murray Co. of Montreal, exclusive agents for the domestic sale of Donnacona Insulating Board products. This agreement is still in effect, thus the company management can concentrate on the problems of manufacture and development, leaving the sales and merchandising in the hands of an experienced and well-constituted organization.

Other production changes of note from 1926 to 1936 included a modest 4000-ton increase in the paper mill, a twofold increase in sulphite pulp production, bringing it to 40,000 tons and the completion of the second generator at MacDougall Falls.

Soon after the purchase of the Sault-au-Mouton limits, the problem of economical river transport of pulpwood led to the design and construction of three special pulpwood motor vessels with a capacity of 250 cords each. Numbers Two and Three are still in service, but Number One went down with all hands in October, 1942, during a fierce storm on the lower St. Lawrence on its way back from Sault-au-Mouton where some of the company's timber limits are located. To this fleet were added two special motor vessels in 1935 and 1936 which were designed to carry a maximum cargo of 225 tons each of finished newsprint from the mill direct to the New York City area via the relatively shallow Lake Champlain and Hudson River routes.

The Past Seventeen Years

From 1936 to the present, Donnacona has shown considerable expansion in all phases of its activities. Successive modifications and improvements to the paper machines increased capacity from 72,000 tons up to the present 105,000 tons. Sulphite pulp capacities were raised to 50,000 tons, while the groundwood pulp mill, with much new equipment, has more than doubled its output which now stands at 140,000 tons, compared to 64,000 tons in 1936.

In 1940, the board mill was given a complete overhaul and the many improvements and modifications increased its capacity from 45,000,000 up to 55,000,000 sq. ft. Again in 1946, a major change was made in the technique of forming the board which resulted in an increase to 75,000,000 sq. ft. Since then, refiners have been added and equipment speeded up, giving the present total of 100,000,000 sq. ft. annually.

To insure an adequate and continuous supply of pulpwood, the company acquired the Bersimis limits of 749 sq. miles from the Brown Corp. and the 112-sq.-mile Madeleine River limits in the Gaspé early in 1952. The total of all limits is 1721 sq. miles of which some 256 miles are freehold.

The last hydroelectric development was the acquisition of the Bird and Son mill site on the Jacques Cartier River where, in 1937, a 2250-hp. generator was installed. Current from this plant joins up with that from MacDougall Falls, the total amounting to 5850 hp.

In the transportation field, a third newsprint carrier was added in 1937, and two more pulpwood vessels in 1946 a 1948. The fleet now consists of four pulpwood vessels wit combined capacity of 1225 cords, and three newsprint carr holding 225 tons each. In addition, three newsprint carr are leased from the Guy Tombs Marine Service.

Apart from the physical growth of Donnacona, there been a parallel growth in the human element. At the star construction, the town of Donnacona was but a small vill catering to the wants of a restricted countryside. As mills grew and prospered, many new homes were erect some by company financing. The newcomers brought n skills which were gradually taught to the native sons, a now some of the second and even third generation are amo the 1000 regular employees in the mills. And there are so whose service spans the entire period. L. W. Michael, n president, came on the site as a young accountant when first clearings were being made in the scrub bush which h overrun the delta, and he remained to see the dreams of first general manager, the late George McKee, far exceed This acquisition by Howard Smith Paper Mills has a lo and interesting history, and, in company with the other m of the group, it can look forward to an even brighter future the country expands its industrial capacities.

BROWN

Nearly 4000 employees depend on Brown Co. and Bro Co. depends on nearly 4000 employees. The homes, famili and standards of living of these people are tied directly to t success or failure of Brown Co.

When business is good, operations are high, pay chec are large and there are plenty of jobs. When business is po operations decline, pay checks are smaller, and fewer p sons are employed.

The success or failure of Brown Co. depends on whet it can make and sell its products in competition with ot companies in the same field of business. Really, it's t simple.

Our business depends on three things—quality of t products we produce; service we give our customers; and t price we charge. All three are in the hands of our employe

If our quality is not as good or better than products ma by our competitors, we lose business. If we can't furnish products where and when the customer wants them, he loc some place else for his materials. If our price is too hig business goes to one of our competitors.

The prices we charge for our products depend on our cos Costs include the price we pay for raw materials; t wages and salaries paid to our employees; the taxes paid local and federal governments; the cost of keeping buildin and machines in good condition; the cost of new buildings a machines; the money paid to railroads, truckers, etc. bring materials to our plants—and also the cost of slo downs

Whenever the cost of operations increases, for any reaso it tends to increase the price of our products. Costs al increase whenever production slows down. Rising costs c endanger the entire company. These rising costs can elim nate profits which provide jobs for the future, or they c force a company out of business.

Machines and departments are designed to show a pro at capacity output. They can pay their way at near capaci operations. But when they drop too much below this, th operate at a loss.

When a machine or a department operates at a loss, drast action must be taken. Either production must be increas or that operation halted. Stopping an operation is hard the employees of that particular department—but it protec jobs of thousands of others.

Our mills and machines are in good condition, but the is still room for improvement. They are designed to man

4 reasons why...

BOARD MILL OPERATORS ARE INSTALLING

FEDRALCO K.P.
WATER DISTRIBUTION SYSTEMS

At present in operation in several mills in Canada, the Karlstrom Persson Shower is proving to be one of the greatest innovations in the Pulp and Paper industry. Consisting of a perforated pipe extending the whole length of the screens, oscillated at a slow speed, the Karlstrom Persson Shower operates at very low water pressure and distributes water over the entire surface of screens, breaking up fibre bundles and separating them out for more complete screening.

NO CLOGGED PLATES

Screening is free and complete. The plates are washed clean, leaving no matted fibre to dry and plug the slots during shut-downs and interruptions. They are ready to screen immediately.

CLEANER SCREENING

Because of free and proper screening, high pressure hosing is eliminated. Dirt is not driven through the plates, nor is good fibre flushed out with the tailings.

LOWER COSTS

With free screening, and little or no hosing required, labour costs are greatly reduced. The saving in labour alone can pay for this equipment in a comparatively short time.

HIGHER PRODUCTION

Because plates are kept clean and screening continuously at maximum efficiency, greatly increased production is obtained.

References as to the success of present installations are available on request.

Manufactured in Canada by

UNION SCREEN PLATE CO. OF CANADA LIMITED

Sold and distributed by

THE FEDERAL MACHINERY & MANUFACTURING COMPANY LTD.

72 QUEEN STREET LENNOXVILLE, QUEBEC, CANADA

FEDRALCO

facture pulp, paper and other allied products economically—when they are operated at or near capacity.

Your help is vitally needed in the campaign to increase production and reduce the cost of our products.

You, as an important part of the company, share the responsibility of making Brown Co. a successful enterprise.

Howard G. Brush, vice-president and treasurer of Brown Co., Boston, Mass., has presented his resignation and Ernest H. Maling, a director of the company and former treasurer, has been elected in his place. Mr. Brush has been with Brown Co. about $6^1/_2$ years and prior to that he was vice-president of Motor Products Co. of Detroit, Mich.

—from *The Brown Bulletin*, April, 1954.

GAIR

Gair Woodlands Corp., an affiliate of Robert Gair Co., New York, has established two 4-year scholarships of $500 each per year to be awarded to outstanding high school graduates to encourage the study of forestry on the part of high school seniors and to further the advancement of the profession of forestry.

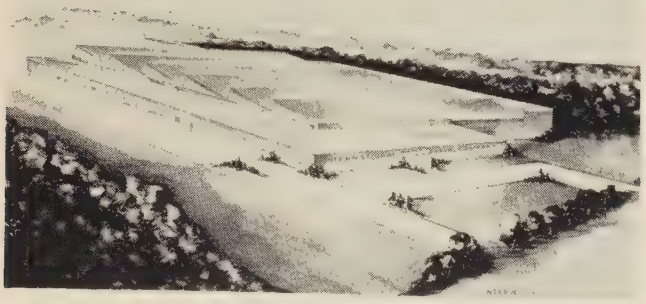
One scholarship is available at the Forestry School of the University of Florida to residents of designated counties in northern Florida. The other, at the Forestry School of the University of Georgia, is available to residents of designated counties in southeastern Georgia and southwestern South Carolina.

Mack A. Higdon has been appointed paper mill superintendent of the Southern Paperboard Corp., Port Wentworth, Ga., a Gair subsidiary. Mr. Higdon joined the corporation as tour foreman in 1948.

I.P.

A new converting plant for the production of Pure-Pak paper milk containers will be constructed in northeast Philadelphia by the Single Service Division of International Paper Co. to supplement the output of the company's existing plant in Norristown.

The new $2,000,000 unit is scheduled for completion in October. It will be erected on a 12-acre tract and will contain 108,500 sq. ft. of manufacturing and warehouse space. When completed, the plant will have a capacity of one hundred million paper milk containers a month. These containers which have a gable top are known by the trade name, Pure-Pak.



Artist's conception of new converting plant to be constructed in Northeast Philadelphia by the Single Service Div. of International Paper Co.

NEPCO

Construction is under way for a $300,000 extension of the Nekoosa mill finishing room at Nekoosa-Edwards Paper Co., Port Edwards, Wis.

The building, 304 ft. long by 110 ft. wide, is part of an overall plan to provide a large increase in warehousing, finishing and shipping facilities. It will adjoin the mill and extend west toward Point Basse Ave. Exterior wall of the one story and basement structure will be concrete block. The entire basement measuring 18,600 sq. ft. will be used for finished paper storage. The basement will be 20 ft. from floor to ceiling, permitting paper to be stored three skids high. Part of the ground floor will also be storage space, and the remainder will allow extension of present paper finishing conveyor lines.

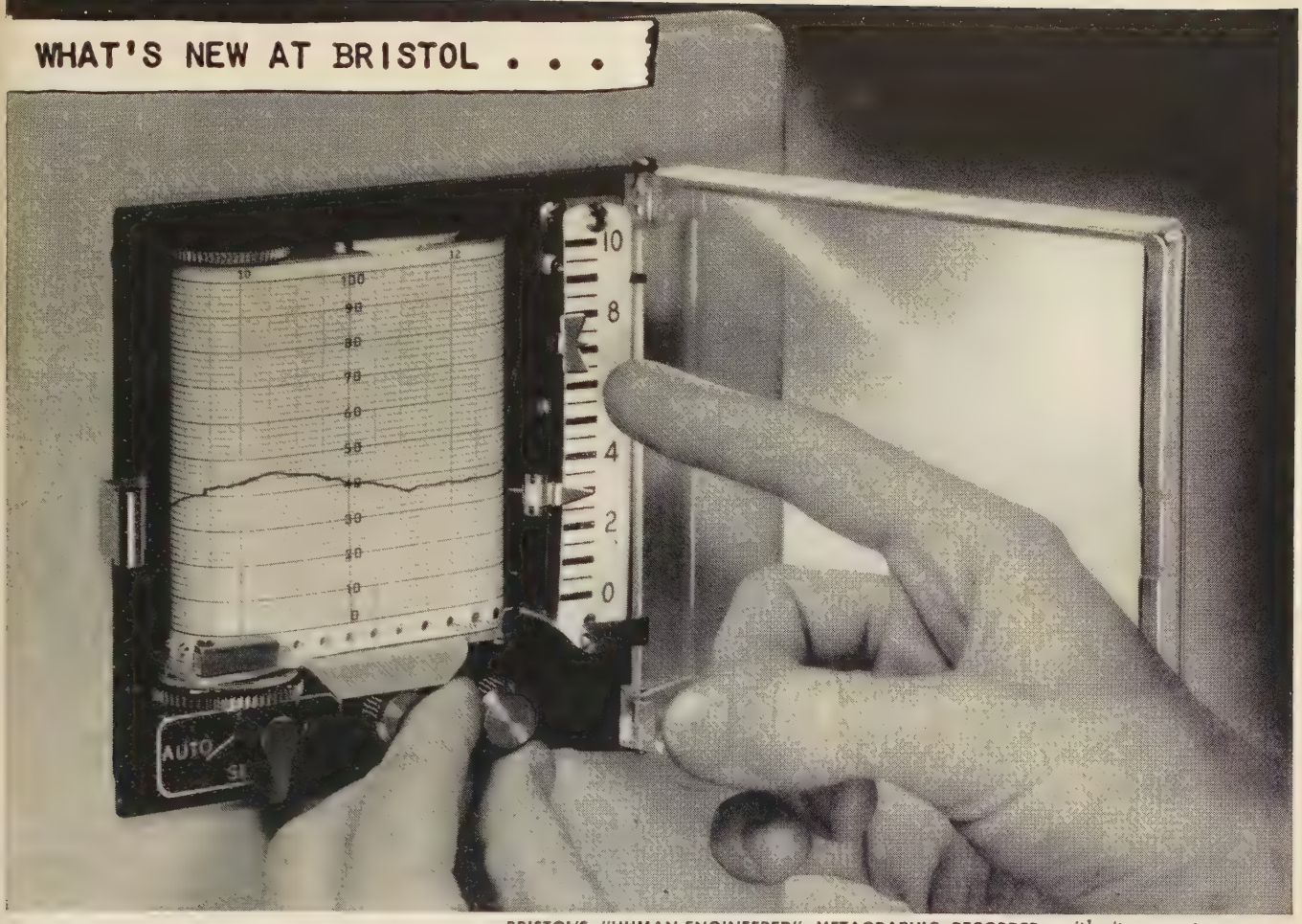
ST. REGIS

A fifty per cent increase in pine seedling production at the Pensacola, Fla., nursery of St. Regis Paper Co. will bring production there up to 18 million seedlings annually. The St. Regis nursery, which is already the largest privately owned nursery in the south, is located adjacent to the St. Regis Kraft Center, a completely integrated operation from the seed to the multiwall paper bags. First established in 1948, the St. Regis nursery was the first industry-owned nursery established in the south. At that time, it had a capacity of five million seedlings as compared with today's crop of twelve million seedlings.

St. Regis has acquired virtually all of the stock of Superior Paper Products Co., Pittsburgh, Pa., through the acceptance by Superior stockholders of the St. Regis offer of exchange of its common stock for Superior stock. Superior will operate as a subsidiary of St. Regis, with its present organization. Superior owns and operates two plants in Pennsylvania, one near Pittsburgh and the other at Mt. Wolf, near York. It employs about 475 people in the manufacture and sale of corrugated fiberboard in various forms for shipping purposes. Its principal products are containers, sheets (single and double wall), single-face rolls and inner packing, with containers representing the major portion of its sales.

St. Regis has acquired management and cutting rights for a period of 60 years on three contiguous tracts totaling ap

A nursery employee inspects one of the 12 million seedlings raised last season at the St. Regis Paper Co.'s Pensacola, Fla. nursery. Its capacity is being increased to 18 million seedlings annually



BRISTOL'S "HUMAN-ENGINEERED" METAGRAPHIC RECORDER, with its easy-to-read scale, high-visibility fluorescent pointers and shadow-proof door has earned the distinction of being the "biggest little instrument in the business."

Instrument men call Bristol's METAGRAPHIC Recorder

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Sounds contradictory, but it's true. Take a look at one of our new METAGRAPHICS mounted on a panel board alongside of other instruments. The Bristol unit stands out — seems bigger than the rest — although chances are it's actually smaller (5″ x 5½″). The answer is that the Bristol instruments have been "human-engineered", making them easy to read, and clearly visible at greater distances.

The air-operated METAGRAPHIC, which records pressure, temperature, vacuum, flow, differential pressure, and liquid level, offers these big advantages:

SIMPLICITY . . . fewer moving parts, fewer adjustments, and less service required. Range changes can be made in seconds. True plug-in service.

CONTINUOUS VALVE-POSITION INDICATION . . . on same instrument scale as set-point scale, gives continuous data on control valve position—makes "bumpless" transfer possible simply by matching pointer positions — no need to read actual scale values — minimizes reading errors — speeds operations.

CONTINUOUS OPERATION . . . complete unit can be retracted for inking pen, and for set-point and zero adjustment without disturbing record or control.

Get the whole story on the "human-engineered" METAGRAPHICS — how they can help you get more accurate measurements, faster and easier. Write us today. The Bristol Company, 102 Bristol Road, Waterbury 20, Conn.

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AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

proximately 70,000 acres of long-leaf slash pine in St. Johns and Flagler counties in Florida.

St. Regis has awarded its Fellowship in Forestry to Philip R. Larson who is currently engaged in silvicultural research at the Southeast Forest Experiment Station in Lake City, Fla. Mr. Larson's proposed doctoral thesis to be carried out at Yale University, is directed primarily toward the pulp and paper industry and will deal with the effect of certain climatic and environmental factors on the wood density and proportion of summerwood in slash pine. The study is aimed at determining what percentage of the total variation in wood density can be attributed to measurable factors. This may make it possible to produce wood of more uniform density through silvicultural practices or genetic improvement.

Wood Flong

At Hoosick Falls, N. Y. near Albany, are located the plant and properties of the Wood Flong Corp.—a continental pioneer in the manufacture of dry mats used in printing.

The "Wood" in the title refers to Benjamin Wood, the original founder of the corporation. The word "Flong," now generally accepted in Canada and the United States, is European for "Mat." Translated in layman's terms, Wood Flong means "mats as originally manufactured by Benjamin Wood."

In the Fall of 1911, after spending considerable time abroad studying in minute detail foreign methods of dry mat manufacture and distribution, Benjamin Wood organized the Wood Flong Co. for the purpose of importing dry mats. As sole agent in the United States and Canada, Mr. Wood began the task of converting domestic daily newspapers from the wet to the dry mat method of stereotyping.

In 1915, Wood produced the first American made dry mat. Newspapers that had discarded their old wet mat equipment and adopted the dry mat process no longer had to rely on a foreign source of supply.

Since 1915, when the first domestic dry mat was produced in Boston, Mass., Wood has pioneered the way in many dry mat innovations. Until 1924, the Wood dry mat was used primarily by the smaller newspapers requiring a limited number of casts or plates from each mat. Realizing the potential market represented by the metropolitan papers, increasing effort was expended in the laboratory to develop a mat which would give the maximum number of casts to the large dailies. Toward the end of 1924, such a mat became a reality and metropolitan newspapers throughout the country promptly became interested.

Until 1927 newspapers and commercial shops using dry mats had to moisten them in a humidor before actually performing the molding operation. This required considerable time. It was during this year that Wood devised a method whereby dry mats could be mill moistened. With this innovation dry mat users were spared this additional task. From that time on, dry mats were shipped from the mill completely ready for use as received. Furthermore, Wood mats were wrapped in such a way as to prevent any loss of moisture over a period of months, provided the mats were properly stored by the consumer.

In 1930 the Wood laboratory scored again with a special coating which was applied to the face of every mat. Coatings as such were far from new to stereotyping. Stereotypers throughout the country had been applying their own coatings to dry mats for many years but mill coated mats were decidedly a new development.

Today, Wood manufactures many different grades of dry mats, each designed for some particular type of work. In recent years, especially during the war, Wood mats were used even more extensively in the commercial field. The Ad, Graphic and Hill Plaxtex grades, developed particularly for the dissemination of advertising material to daily and weekly newspapers and also for fine register color work, have become

a size for every mill

CHEMI-PULPER®

continuous digester

Units from 2 to 8 tubes capable of producing up to 100 tons of high grade pulp per day.

CHEMI-PULPER continuous digesters are producing quality pulp for mills making products ranging from board to bleach grades.

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extremely popular among advertisers and advertising agencies.

One problem which has faced the Wood Flong Corp. in the past few years has been the high shrinkage demanded by newspapers.

In the short space of 20 years the shrinkage of a newspaper mat has risen from $^{3}/_{16}$ to $1/^{5}_{16}$ in. This means controlled shrinkage plus or minus $^{1}/_{16}$ in. on an area approximately 16 in. wide.

Wood has been foremost in supplying this controlled shrinkage to newspapers in all portions of the United States and 30 foreign countries.

Constant research is conducted in the Wood laboratory, with the belief that therein lies the means of discovering improved methods of blending raw materials, refining, finishing, and controlling quality in general. The aim and ever constant goal is the best dry mat possible at the lowest possible cost, realizing a product well made is more than half sold.

THILCO

America's wood supply has an interesting history; especially so to us who depend on wood from which we make an extremely high quality paper.

The first cargo of wood from America to Europe in 1603 consisted of sassafras bark for the rumbling stomachs of our British forbears. Just two years later, in 1605, the first cargo of pine logs was shipped from Maine. The British government, in need of logs for ship masts, sent agents to America to pick the finest logs for government use, mark them with the King's broad arrow, and forbid anyone else to cut them. In such a manner was the American pine tree introduced to government. There has been a close relationship ever since.

In 1690, paper was first made in Philadelphia. But it wasn't until the middle of the last century that paper was widely manufactured from wood pulp. Groundwood pulp was introduced in 1840; chemical wood pulping by the soda process in 1854; and sulphite process pulp in 1866. As the demand for more and more paper grew in the United States, the paper companies were forced to reach further afield for pulpwood that would serve their needs.

Some sections of the country do not grow the particular type of wood needed to make certain kinds of paper. When forests are not properly cared for, or are cut over, other sources of supply must be found until the trees in short supply have a chance to grow again. That's pretty much what has happened in the Lake State area over the years. The original stands of pulpwood trees must be given a chance to grow to maturity. The story of Thilmany's quest for new supplies in many areas is told elsewhere in this issue; Montana, Minnesota, and Canada supply a large portion of our pulpwood now. But Wisconsin forests are growing in size and productive pulpwood yield. With proper care, our own timber stands will again produce a share of the pulpwood used in Wisconsin.

When we say proper care, we mean intelligent, businesslike cultivation of the pulpwood "crop." If let completely alone, trees grow too thickly to get the most out of the land. If a tract is thinned the remaining trees grow faster and sturdier. It may suprise you to know that "virgin" timber does not necessarily represent conserved natural resources. Rather, uncut timber sometimes represents waste . . . and a lot of it. Therefore, properly managed timberland is like a crop of corn. It must be cultivated, thinned, managed, and harvested regularly in order to produce.

Our forests are pretty much like a bank account. When you put your money in say, the Thilco Credit Union, you call it your "capital" and the Credit Union pays you "interest" on it. Trees now standing are our capital, and the wood that grows on them each year is interest. So we harvest the wood, and in effect, spend our interest without growing any poorer. Proper management keeps the capital intact and producing.

USE THE OIL THAT CLINGS!

Forget the lubrication marathon that keeps one or more men busy all the time lubricating surfaces where ordinary oil doesn't stay put long enough! Where ordinary lube oil drips and runs off, Magnus Kling-Oil stays on the job. Its lubricating quality is equal to that of any good SAE 30 oil, but because Kling-Oil is tacky as well as mobile, it *stays put much longer* . . . eliminating many of the oilings formerly required.

No Drip . . . No Splatter . . . No Puddling

You'll have a safer and far neater mill when you use Kling-Oil. And because lubrication will always be at top-notch effectiveness, you can expect worthwhile savings in power consumption.

THERE'S A FREE SAMPLE READY FOR YOU. ASK FOR IT!

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Anyone who applies scientific forest management so as t assure abundant forest crops is a friend of the forest . . and of you, your children, and your children's children.

—from *Thilco News*, March-April, 1954.

BIRD

A layer of scale of no more than eggshell thickness is enoug to put our big high-pressure boiler out of action. Dissolve gases present in ordinary river water would, under pressur and temperature, actually eat holes in the steel boiler tube These are some of the difficulties we face in operating our nev boiler at East Walpole, which is as big as a five-story building The use of huge quantities of water in such a high-pressur boiler gives rise to some of the major problems with whic power engineers are faced.

Let's see why.

We all know that the source of the world's supply of fres water is either rain or snow, but contrary to popular belief rain water is not pure. While falling through the earth' atmosphere, it absorbs considerable quantities of gases such as oxygen and carbon dioxide. It also picks up considerabl dirt and dust, some of which dissolves. On striking the earth, part of the rain evaporates back into the atmosphere which produced it originally, part becomes "run off" forming brooks, ponds, and lakes, and the very important remainde sinks into the earth where it becomes known as "ground water." It is this ground water which keeps our brooks and rivers replenished by slowly seeping out of the ground. A good example of this may be seen in the many springs found in this part of the country, especially in the swamps.

In its journey over and under the surface of the earth water comes in contact with many kinds of rocks. Some o these rocks are very hard and some are quite soft, but in any case, parts of both dissolve in water to some extent, just as sugar dissolves in coffee. Water which is left in a glass bottle will in time take on an appreciable increase in silica content simply because some of the glass is dissolved. It is for this reason that we use plastic bottles for silica determinations o boiler water.

Besides actually dissolving in water, small particles o rock, soil, and clay are carried along as suspended matter which in some areas, gives surface water a cloudy appearance In our vicinity, the Neponset River flows through numerous swamps where it picks up a slight color from decaying leaves and other vegetation. It is very evident, therefore, that surface or subsurface water which originated as rain, contains gases from the atmosphere and dissolved or suspended mineral matter as well as organic material.

Minerals Harmful

The cool clear spring water which is so refreshing on a hot Summer's day may contain dissolved mineral matter which is very beneficial to one's health, but this same water would, in all probability, be ruinous to a high-pressure boiler if it were used "as is." To illustrate the effect of such a water, we can go back to the tea kettle which was a common sight on most kitchen stoves not too long ago. Most of us are aware that the old tea kettle had to be cleaned out once in awhile, because of the layer of hard crust or scale which deposited on the inside. This scale which was left behind as the water was boiled away over a period of time, is actually the mineral matter dissolved from the rocks of the earth. If the layer of scale becomes thick enough, it retards the passage of heat from the fire into the water, making it harder to boil the water.

Scale

A tea kettle of course, bears little resemblance to a modern boiler, but fundamentally it operates in the same manner. We fill the kettle with water, put a fire under it, and after a time steam comes from the spout. Scale formation is identical with the condition we get in boilers from using untreated water.

Scale in the tea kettle does no particular harm but serious damage would most certainly occur if this happened in a high-pressure boiler. With high temperatures and pressures prevailing, scale causes the parts to overheat and possibly burst.

Dissolved Gases

The part played by dissolved gases in boiler water is rather different. As stated before, if not removed, they become very active under pressure and temperature and will actually eat holes in the steel. High-pressure boilers are so sensitive to the quality of water they receive, that it is no exaggeration to say that some substances such as soda water, which could be put into a baby's stomach with no dire consequences, would seriously damage a big boiler. They are also extremely sensitive to deposits on their heating surfaces.

The preparation of water for use in boilers such as ours is a major problem. The usual procedure is to have experts prescribe mechanical and chemical means of treatment to fit the individual boiler plant. Knowledge in this field has advanced greatly in the last 20 years. Increasing boiler pressures have demanded closer and more dependable control of boiler water conditions, so that today this type of work has developed into a science in its own right. New discoveries are continually being made and we at Bird & Son naturally wish to take advantage of any of these which has been proved in practice and which will give us better and more economical operation.

How We Do It

Here at East Walpole we first make sure the water is freed of its harmful gases. This is done by spraying it into a chamber filled with steam at 220°F. The combined spraying and heating causes the water to release the gases, which are vented to the atmosphere. The water is now said to be "deaerated" and is ready to have harmful organic matter and suspended solids removed. This is done by a curdling process called coagulation which roughly corresponds to the effect we get when milk and orange juice are mixed. Chemicals such as lime and alum, lime and soda ash, or caustic and Epsom salts are used for this. At East Walpole we use magnesium oxide and caustic soda.

We won't attempt to go into the complicated chemistry involved, but in brief, these chemicals react to form a "floc" composed of fluffy appearing masses of great volume. This substance is quite heavy and in sinking carries with it all of the color, organic matter, and suspended solids.

Removing Silica

Another benefit of equal importance is the removal of silica in this process. The magnesium oxide floc adsorbs the dissolved silica and in the process of clarifying the water, removes the silica which is drawn off with the sludge. Control of silica is very essential for two reasons. First of all, in itself, or in combination with other impurities, it can deposit as an extremely hard scale which is very difficult to remove from the boiler. Even acids are ineffective unless special ingredients are added. Silica, in some cases, evaporates with the steam only to deposit in the turbine blades. So far the only effective means of removal from turbines is to dismantle the machine and sand blast the rotor with specially prepared abrasive sand and other materials such as ground-up coral. This process is expensive and time consuming.

Filtering

Up to this point we have removed organic matter and suspended material. Silica has been reduced to a minimum and objectionable gases driven off. Next we send it through filters to remove the last traces of any coagulating material that may have failed to settle out. The water is now crystal clear but it still contains substances which give it some degree of what is known as "hardness." This is also a scale-forming material and for its removal we use apparatus which is nothing

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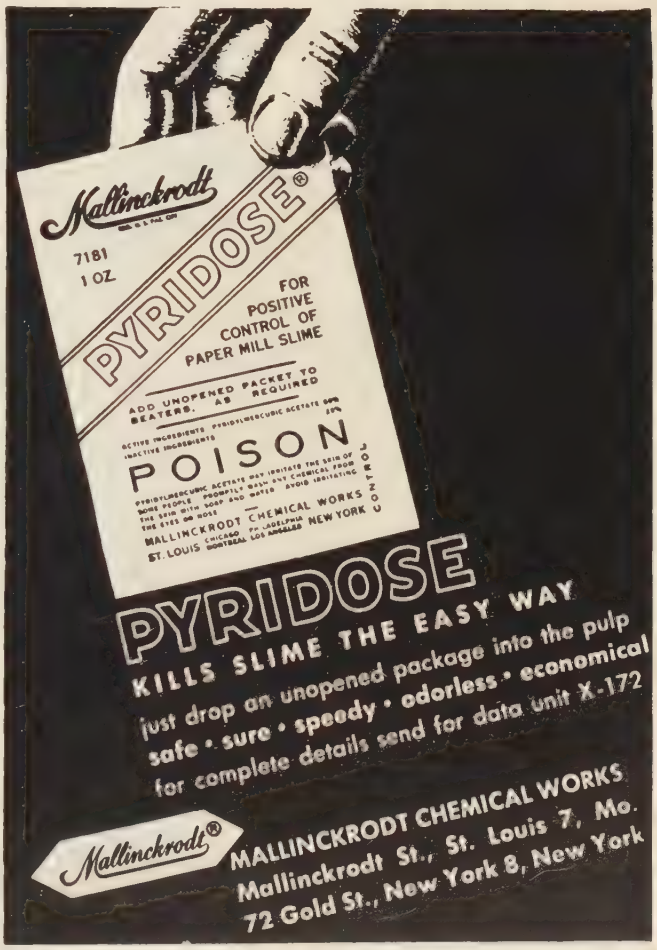

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Carbon blacks for color
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We are qualified to handle the biggest job you can give us. For example, a job which we recently completed in Florida took 75 carloads of tile.

We give you top-quality service on little jobs too. The installation of a fitting in a Wisconsin bleach tower required the replacement of only three tile — but it received our best workmanship.

It will pay you to investigate Stebbins tile construction as compared with any other type. Prompt service throughout North America.

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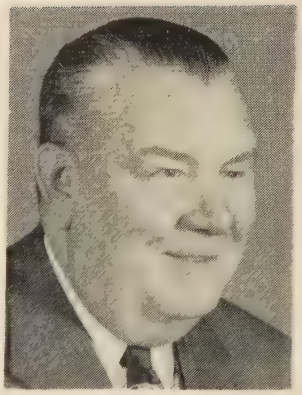


C. A. Sorg

D. J. Goodman

Sorg Paper Co.

less than miraculous to those of us who have to do with boiler plant operation. These devices are called hot zeolite softeners. They were installed in 1953 after many plants throughout the country had demonstrated the improved operation resulting from their use.

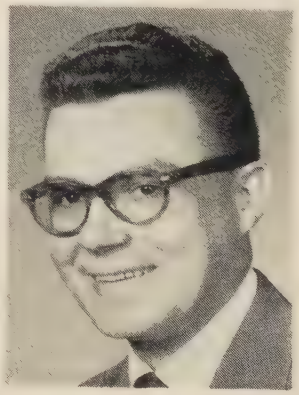
Use of Amberlite

In our case these resemble a round filter bed encased in a tank about 6 ft. high and 8 ft. in diameter. The filling is composed of fine amber-colored globules of synthetic resin called "Amberlite." The softening of water by such materials is a comparatively recent innovation. The older type zeolite softeners as used at Phillipsdale and Shreveport are filled with a mineral sand which has natural water softening properties. It is cheaper than the synthetic product but is less efficient and will not work in hot water which is one of the requirements at East Walpole.

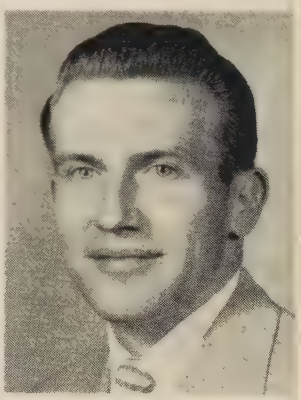
The simplest way to describe the operation of softeners is to say that they exchange scale-forming materials for those which don't form scale. They must be "charged up" by running strong salt brine through the beds. The process may be compared to charging a storage battery. Rock salt is dissolved in water and a given amount of brine pumped through the softener. Then the salt is washed out and the softener is ready to soften 1,000,000 or more gallons of river water to a point where it is very difficult to find even a trace of hardness. Around the 1,000,000 gallon mark they show signs of weakening so we give them the salt routine again. This brings each unit to life and ready for another million gallon run.

More Steam

With the old system there was little or no silica reduction in the feedwater so that to keep it at a safe figure in the boiler, it was necessary to remove excessive amounts of boiler water. This resulted in a waste of chemicals and heat in the water

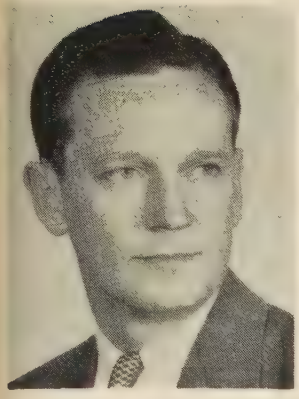


R. A. Buck

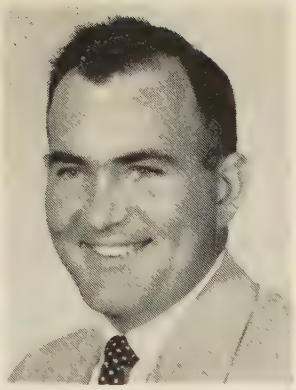


C. F. Hill, Jr.

Sorg Paper Co.



C. H. Eisenmenger



J. F. Nolan

Sorg Paper Co.

blown off. The hardness had to be compensated for by injecting other chemicals into the boiler. This resulted in deposits which could only be removed by expensive acid cleaning. Besides reducing these expenses, the new equipment gives us better operation. We are now able to generate more steam with the high-pressure boiler.

Depend on Chemists

In any operation of this kind, exact control is a must, and to get this control we are very much dependent on the expert advice of our Laboratory which in turn works closely with our water consultants.

—by O. M. Lambine in *Bird Neponset Review*, April, 1954

SORG

The following appointments have been made recently by the Sorg Paper Co., Middletown, Ohio: Claude A. Sorg, production manager; Donald J. Goodman, general superintendent of papermaking; Carl H. Eisenmenger, general superintendent of finishing and service departments; John F. Nolan, superintendent of the company's Ogelsby mill; Russell A. Buck, superintendent of the converting department; and Charles F. Hill, Jr., assistant technical director.

MATERIALS HANDLING SHOW

The next Materials Handling Exposition will be held in Chicago during the week of May 16, 1955. The theme of the show will be "The Concept of Obsolescence."

MACON

James A. May, assistant to the vice-president and general manager of Macon Kraft Co., since January, 1949, has been appointed resident manager, and William M. Ebersole, general superintendent since January, 1952, has been appointed manager of production of the Macon Kraft Co.,

J. A. May

W. M. Ebersole

Macon Kraft Co.

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HIGHEST QUALITY
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We are located in the heart of the great southern textile and paper industry, which assures speedy and efficient delivery to these two growing industries.
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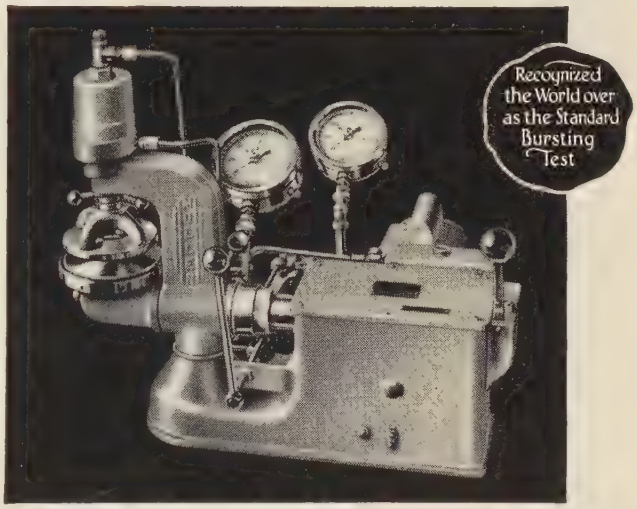
Motor Driven Model A Tester With Hydraulic Clamping Device



Especially designed for testing corrugated container board. Larger clamping area and reproducible clamping at any desired pressure eliminates crushing and slippage of the sample.

Write today for prices on these new testers, also the cost of converting your present Model A machines.

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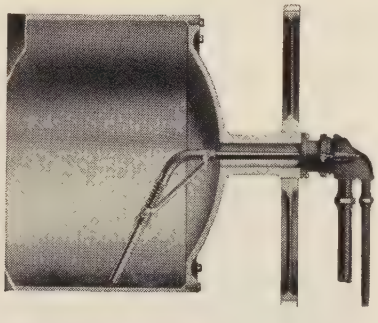


Superintendent X had the Answer

"We wouldn't keep buying them if they didn't work." That is what superintendent X, who knew, recently told superintendent Y still on the fence.

They were talking about Midwest Auto-flex syphons, thousands of which are today in service because they hold their position and wear indefinitely.

The spring and brace holds the end of the pipe at the proper distance from the bottom of the dryer. It cannot possibly take any other position—hence, proper water and air removal.

The cantilever leverage exerted is lower than with bent pipe syphons, only 170# vs. 354#. It clears instead of dragging on the journal and rapidly wearing out.

Order a few and you'll order more. Performance as stated guaranteed.

MIDWEST · FULTON MACHINE COMPANY
DAYTON, OHIO

Macon, Ga. Herbert A. Kidd, vice-president and gene manager of Macon Kraft, vice-president of Mead Corp., a general manager of Rome Kraft Co., has moved his office Rome, Ga., from where he will direct the operations of b Macon and Rome.

Consolidated

As part of a celebration of its 50th anniversary, the C solidated Water Power and Paper Co., Wisconsin Rapi Wis., recently exhibited a scale model of a sulphite mill co plete with a schematic evaporator plant for processing sp sulphite liquor into raw materials for adhesives and ot useful products.

The Night Shift Done It

When Cheops built his pyramids
Of mortar, stone and brick,
He thought he'd put a night shift
On to do the job real quick.

But government inspectors checked
A lot of work unsound,
And called the biggest boss-man in
To show him what they found.

The latter looked upon the scrap
And grief was in his gaze.
He sadly shook his head and said,
"We don't do that on days."

When Noah built himself an ark,
Things didn't do so well,
He feared he'd not complete the
Thing in time to beat the swell.

So he installed another shift
To do the job up right.
And signed a union contract
For working day and night.

But trouble overtook him,
And parked right in his lap:
The night shift, Noah was informed,
Was making all the scrap.

The leaning tower of Piza
Is a wonder to behold.
But here's a little inside dope
That never has been told.

It's a very ancient story,
And always runs the same.
Since the day shift didn't do it,
The night shift is to blame.

What's more, on molded blueprints
A tower straight is seen.
But the fellows on the night shift
Made the leaning tower lean.

I've worked in many modern shops
And this is what I've found:
The scrap is always made by guys
Who never are around.

The other shift makes all the scrap.
They never work with care.
The only man who scraps a piece
Is the one who isn't there.

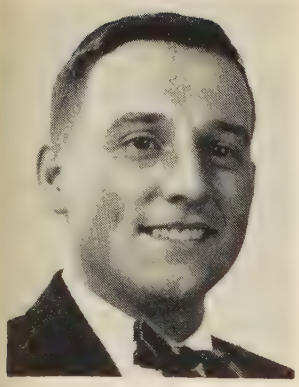
I'm not the kind to intimate
That any man would lie.
But don't you think it's nearly
Time we changed our alibi?

Safety Congress

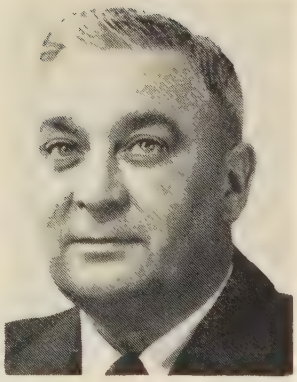
The 42nd National Safety Congress and Exposition is be held October 18–22, Chicago, Ill. Sessions on industri safety scheduled for Conrad Hilton, Congress, Morrison, ar La Salle Hotels; traffic safety sessions at Congress Hote commercial vehicle and transit safety sessions at La Sal Hotel; farm safety sessions at Palmer House; school safet sessions at Morrison Hotel, and home safety sessions Conrad Hilton Hotel. For further information write R. Forney, General Secretary, National Safety Council, 425 Michigan Ave., Chicago 11, Ill.

Laboratory Directory

The *Directory of Commercial and College Laboratorie*



Lowell Brown



W. H. Schaffner

Albany Felt Co.

hitherto compiled and published by the National Bureau of Standards of the U. S. Dept. of Commerce, will be published in the future by the American Society for Testing Materials.

ALBANY

Albany Felt Co., Albany, N. Y., has modified its sales territories as follows: Lowell Brown now services paper mills in California, Colorado, and Oregon. Harry Stilwell covers Washington, British Columbia, and Alaska. William H. Schaffner is servicing mills in the deep South, and John Howell is covering mills in Connecticut and New York.

WITCO

Witco Chemical Co., 260 Madison Ave., New York, N. Y., has published a bulletin (W-1) giving technical data on the use of precipitated calcium carbonate as an inert filler in polyester resins for molding or casting.

Witco has increased the output of its asphalt plant at Perth Amboy, N. J., by building an addition to the cooling and shipping shed.

James E. Cunningham has been appointed to Witco's New York sales staff.

GRAVER

Graver Water Conditioning Co., 216 W. 14th St., New York, N. Y., has opened a Western European office in Copenhagen, under the direction of Jorgen Berring, to handle sales, installation, and servicing of industrial and municipal water treatment and waste treatment equipment in the Scandinavian countries and Western Europe

A Graver bulletin (WC-115) describes Graver diatomite filters for industrial use.

DOWNINGTOWN

Emerson N. Glauner, Sr., has been appointed sales manager of the Downingtown Mfg. Co. Jacob V. Edge is now as-

John Howell, Albany Felt Co.

E. N. Glauner, Sr., Downington Mfg. Co.

DYESTUFFS
and
AUXILIARIES
for the Paper Industry

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★ COATING MACHINE

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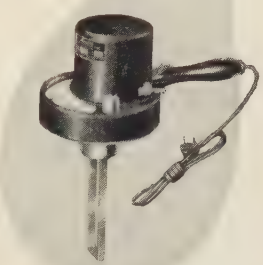
TO THE BETTER CONTROL OF COATING COLOR BEHAVIORS



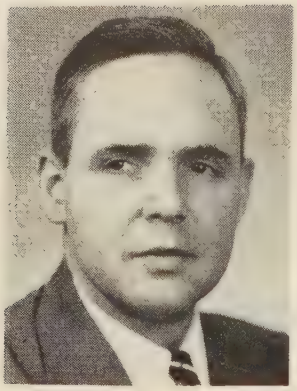
With a multipoint Brookfield Viscometer on the job, it is easy to check the effect of dispersant additions on the rheological properties of your starch-clay, casein or pigment-combination colors.

Ideal for use both in Labs and at points-of-process, you just flick the switch on your Brookfield Viscometer, read the dial and have your determination directly in centipoises.

High accuracy *plus* high sensitivity are inherent in the Brookfield principle of operation — direct indication through a calibrated spring of the torque on a rotating spindle.

Brookfield Viscometers are portable and plug into any ac outlet. Send for fully illustrated 1954 catalog listing all models and accessories. Also ask for special technical article on "Rheology of Paper Coatings." Write today to Dept. T.

Brookfield ENGINEERING LABORATORIES, INC.
Stoughton, Mass.



J. V. Edge

R. W. Polleys

Downington Mfg. Co.

sistant sales manager in charge of building board machinery and R. W. Polleys is assistant sales manager in charge of stock preparation equipment.

TESTING MACHINES

Testing Machines, Inc., 123 W. 64th St., New York, N. Y., is now producing the TMI-Beach Puncture Tester for testing corrugated board, vulcanized fiber, wallboard, fiberboard, plywood, heavy liner, etc.

HONEYWELL

Minneapolis-Honeywell Regulator Co., Philadelphia, Pa., has published a bulletin (9050) on instrumentation for steam generation, and a catalog (2320) describing all types of flowmeters made by the company's industrial division. Catalog 5001 is a revised composite catalog, giving brief descriptions of all Brown instruments, and catalog 9301 covers radiamatic pyrometers for measuring temperature from 125 to 700°F.

LINK-BELT

Rodney F. Coltart has been appointed sales manager of the Central Pacific Div. of the Link-Belt Co., with headquarters at the company's San Francisco plant. Benjamin M. Prestholt is now sales manager of the Southern Pacific Div., with headquarters at the Los Angeles plant.

Link-Belt has published a book (No. 2425) giving technical data on silent chain drives.

BURTONITE

The Burtonite Co., Nutley 10, N. J., has issued a leaflet giving technical data on Burtonite No. 7, a guar gum extracted by a newly introduced, European process.

WOLFERZ

E. C. Wolferz Alloy Equipment, Belleville, N. J., has introduced automatic welding in various alloys for pipe sizes of 4 in. o.d. and up.

B & W

P. R. Grossman has been appointed chief research engineer at the Research and Development Center of The Babcock and Wilcox Co., Alliance, Ohio. G. A. Watts has been appointed superintendent of the products section, and J. F. Wachimas superintendent of the technical services section. W. J. Thomas, general manager of the Tubular Products Div., has been named a vice-president of the company.

FOSTER WHEELER

Charles C. Hornbostel has been appointed administrative assistant to the president of Foster Wheeler Corp., 165 Broadway, New York, N. Y.

I-R

Ingersoll-Rand Co., 11 Broadway, New York, N. Y., has published a booklet dealing with the selection of the proj motor pump for any specific job.

BECCO

Buffalo Electro-Chemical Co., division of Food Machine and Chemical Corp., Station B, Buffalo 7, N. Y., has issue Becco Research and Development Dept. bulletin (No. summarizing the most useful methods of assaying hydrog peroxide solutions.

MAGNUS

The Magnus Chemical Co., Garwood, N. J., is offering compound, Magnus 81XX, for cleaning cooked rag wash screens without dismantling them.

ARMSTRONG

Armstrong Machine Works, Three Rivers, Mich., is pr ducing a new larger model integral strainer steam trap, des nated as No. 882, to handle from 1300 to 2200 lb. condensa per hour. The new trap is said to cost less than a standa trap plus separate Y-type strainer.

A-C

Allis-Chalmers Mfg. Co., 828 S. 70th St., Milwaukee Wis., has issued a bulletin (28 x 7501A) on water treatment f cooling towers.

ROHM & HAAS

Rohm & Haas Co., Resinous Products Div., Washingt Square, Philadelphia, Pa., has published a booklet, "If Y Use Water," explaining the fundamentals of the vario industrial water treatment processes.

OLIN-MATHIESON

Olin Industries Ltd., and Mathieson Chemical Corp. ha merged to form a new corporation known as Olin Mathies Chemical Corp. John M. Olin is chairman and Thomas Nichols president of the corporation.

Olin-Mathieson has total assets of about $500,000,000 a sales over $500,000,000, including sales of nonconsolida subsidiaries and licensees.

HERCULES

Hercules Powder Co., Wilmington, Del., is constructing new chlorinated rubber unit at its Parlin, N. J., plant, whic will step up production of Parlon by 50%.

Hercules has published a new technical booklet for t paper industry, describing the advantages of using Hercul CMC for gloss ink printing.

HOOKER

Recently appointed to Hooker Electrochemical Co.'s R search and Development Dept. are Joseph J. Wylegala, Em J. Geering, and Paul E. Hoch.

WARREN

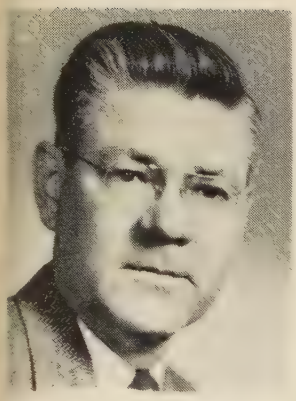
Warren Steam Pump Co., Warren, Mass., has issued bulletin (234 Revised) describing Warren Type SOD pap mill stock pumps.

STOWE-WOODWARD

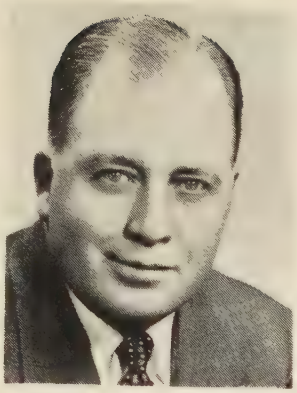
Stowe-Woodward, Inc., Newton Upper Falls, Mass., installing a branch plant for rubber roll production at Neenah Wis.

SOCONY-VACUUM

Henry K. Chapin has been appointed manager of th Wholesale Div. of Socony-Vacuum Oil Co., 26 Broadway, Ne York, N. Y. Warren A. Beman replaces Mr. Chapin as a sistant manager in the Industrial Div. in charge of chemica products.



A. W. Ayles, Morningstar, Nicol, Inc.



R. R. Newquist, Roots-Connersville Blower

MORNINGSTAR, NICOL

A. Walter Ayles has been appointed to the southern territory of Morningstar, Nicol, Inc., New York, N. Y., to handle sales and service for the company's paper mill department.

ANACONDA

American Brass Co., American Metal Hose Branch, Waterbury, Conn., has published a bulletin (STC-1) describing flexible stainless steel tubing for conveying corrosive liquids and gases at high temperature.

BROOKFIELD

Richard A. Minard has been appointed technical sales manager of Brookfield Engineering Laboratories, Inc., Stoughton, Mass.

ROOTS BLOWERS

Roots-Connersville Blower, a division of Dresser Industries, Inc., is celebrating this year the one hundredth anniversary of the discovery by the Roots brothers, Francis and Philander, of a principle for creating positive mass movement of gas and air that has remained basically unchanged since 1854. It was in that year that the first Roots industrial blower was made.

Today Roots blowers are performing in iron and steel plants, mines and smelters, refineries and gas works, food and chemical plants, water works and sewage disposal plants, paper and textile mills. They scavenge and supercharge diesel engines, ventilate mine borings and tunnels, provide air for large-scale engine and carburetor tests. They supply pressure for wind-tunnel aircraft tests, for aeration and agitation of various liquids, for combustion and heat treating, for pneumatic conveying. In short, Roots blowers are doing most jobs of moving gas and air at moderate pressures.

The nameplates on some of the Roots blowers around the world are coated with industrial grime that has been gathering for decades. Forty years of operation without a breakdown has become commonplace. One blower has been operating for 78 years. It is supplying air for a New Jersey mineral wool plant; installation date, 1876. In Cleveland, Ohio, a battery of new blowers is being installed at the municipal sewage disposal plant. They will be placed side by side with another battery of Roots blowers that was installed in 1914 and is still in full-scale operation. Function of the blowers in this case is to provide bubbling action for activating sludge. The reason Cleveland is buying new blowers is that it is expanding the sewage plant.

The list of American companies a hundred years old is growing steadily. However, only a few, if any, can lay claim to producing the same basic product they started with. Rarely does an original idea prove sound enough to keep pace with a hundred years of rapid industrial growth and still remain as good as the day it was conceived. Improvements have been made in housings, bearings, mechanical details, and in the metals contained in the machines, but it has not been possible to improve on the principle of counter-revolving impellers machined to a tolerance that brings them close enough to carry air with minimum loss but not close enough to touch each other or the casing that houses them.

The figure-eight shaped impellers, as they revolve, scoop in a measure of air at the intake, carry it around to the outlet, then go around for another load. Thus a positive movement of air—or gas—is accomplished.

A Roots catalog dated 1891 describes the process thus:

"The positive blower measures and forces forward at each revolution a fixed quantity of air, whether the pressure be high or low, or the speed fast or slow, and the amount of air delivered can be accurately determined and controlled, and the exact quantity necessary to effect the perfect combustion of a given amount of fuel in a given time, supplied with perfect certainty.

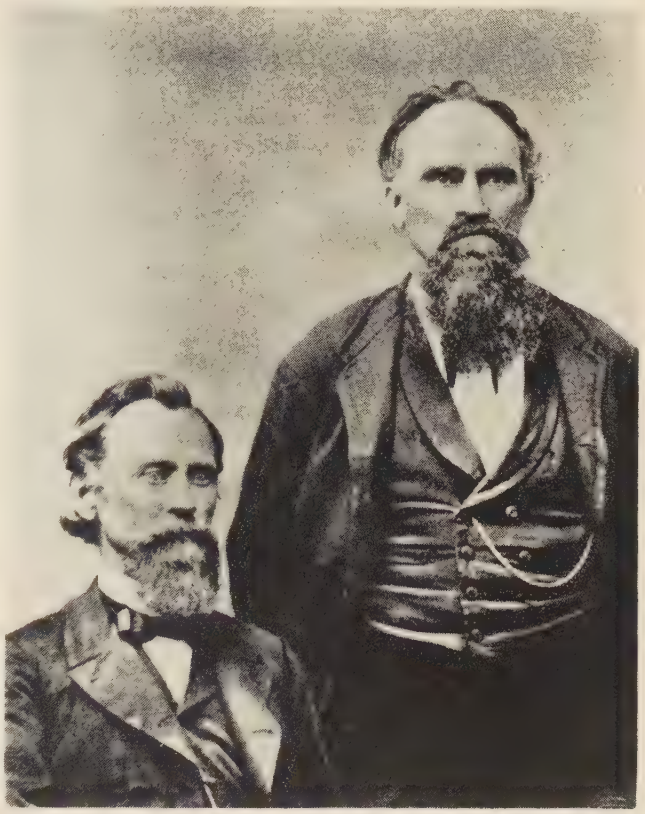
The Roots principle, basically, is as simple as that.

Curiously enough, the Roots brothers' discovery was accidental. While searching for a more efficient means to power their woolen mill, situated on the bank of the Whitewater Canal at Connersville, Ind., they set about to improve on the overshot waterwheel they had been using.

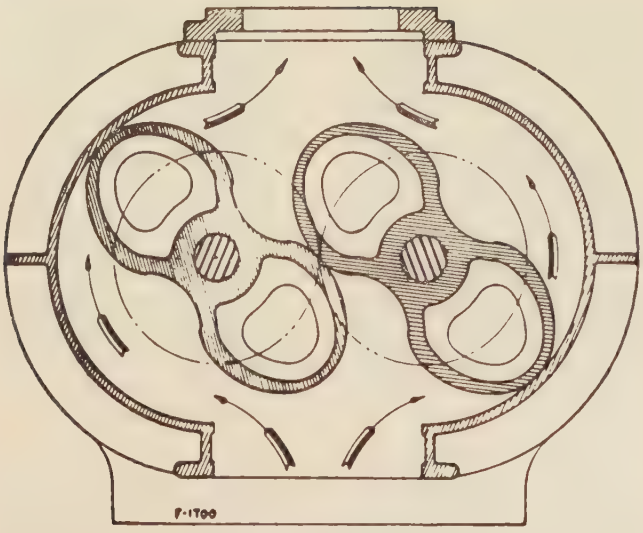
The machine they devised was judged a complete failure as a water motor and was all but abandoned. They noticed, though, that a constant stream of air issued when the paddles, or impellers, were set in motion. It occurred to them to try it as a blast blower in a foundry cupola. The idea was a success, providing more complete combustion than had ever been achieved.

The brothers made blowers as a sideline to their principal business at the woolen mill. Their machines proved so successful, it was not long before they concentrated on blowers and abandoned the woolen mill as their main pursuit.

As early as 1867 the Roots principle for positive blowers received international recognition. Their blowers were given the highest award for machinery of that class at the great



The Roots brothers, Philander (left) and Francis, who evolved the Roots principle for rotary positive blowers that has remained basically unchanged for a century



The Roots principle—simple, basic, enduring. Two accurately machined impellers revolve in opposite directions on parallel shafts, within an accurately bored casing. As they rotate, gas or air is drawn into the space between the impeller and casing, where it is trapped as the tip of the impeller passes the edge of the outlet opening and this volume of gas or air is pushed into the discharge pipe. This action occurs twice for each revolution of each shaft and impeller, or four times for each revolution of the drive shaft. Relative position of the two impellers is maintained by a pair of accurately cut gears at one end of the shafts. Net result—positive movement of air or gas

Paris Exhibition. From that time on they have won honor after honor, both national and international.

As the fame of Roots blowers spread the variety of uses to which they were put increased. In New York City, for instance, a Roots blower was the motivating power in the pneumatic tubes at the Western Union Telegraph offices. Also in New York City, and this probably is the most fascinating use ever found for a Roots blower, a block-long subway was built in 1870 in which a passenger car was propelled by air from one end to the other. A Roots blower supplied the push behind the car.

Present status of Roots-Connersville Blower as a division of Dresser Industries was achieved after a succession of changing ownerships and mergers. Original builders of blowers, of course, were the Roots brothers who operated under the name P. H. and F. M. Roots Co. In 1893, though, a Roots engineer, one John T. Wilkin, had an idea for an improvement and took out a patent. He broke away, obtained financial backing, and formed the Connersville Blower Co.

The two firms operated as competitors, both at Connersville, Ind., until the Summer of 1929. In that year both firms were purchased by an Ohio syndicate. They were operated separately but were under control of the Stacey Engineering Co. In 1931, Stacey Engineering merged with the International Derrick & Equipment Co. of Columbus, Ohio. Under the administration the P. H. and F. M. Roots Co. and the Connersville Blower Co., still operating as separate units, were merged.

The final change in ownership came in 1944 when Dresser Industries, Inc. of Dallas, Tex., acquired control to round out their services to the gas and oil industry.

In addition to the rotary positive blower, the company now makes centrifugal blowers and exhausters, positive displacement meters, vacuum pumps, inert gas generators, and its latest, a spiraxial compressor.

Du Pont

E. I. du Pont de Nemours & Co., in cooperation with Alco Gravure, has developed a new light-sensitive material called Roto Film, which promises to simplify gravure printing by eliminating the sensitizing operation at the printing plan and by shortening the exposure time needed in making gravu resist material.

Newport News

Newport News Shipbuilding and Dry Dock Co., Newpo News, Va., has established a foundation to award two annu scholarships for students of the Newport News Shipya Apprentice School. The awards will be known as the Hom L. Ferguson Scholarships.

Dowell

Dowell, Inc., Tulsa 1, Okla., a subsidiary of Dow Chemic Co., has issued leaflets on the Dowell service for tank cleani and for cleaning of air conditioning and refrigeration systen

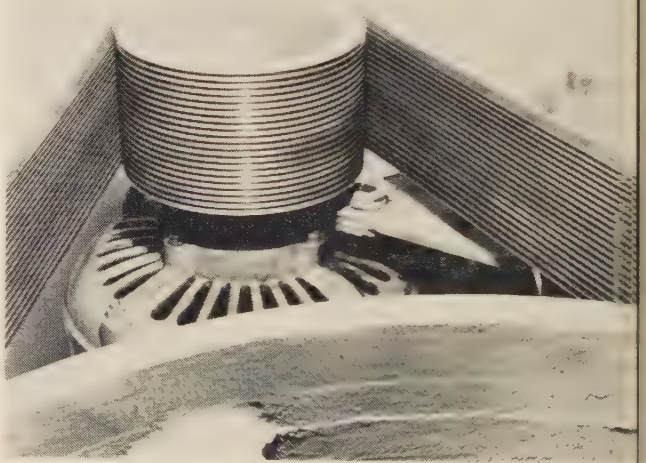
Reliance

Reliance Electric & Engineering Co., 1088 Ivanhoe Ro Cleveland, Ohio, has published a bulletin (B-2102) design to help in choosing Reliance motors for 1 to 200-hp. applic tions.

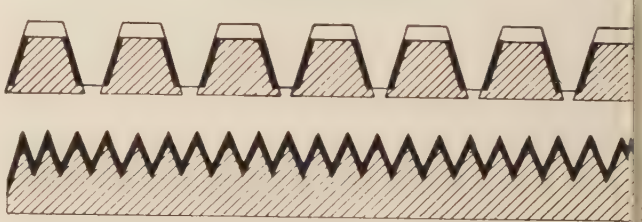
Reliance has also produced the "Compar-A-Frame" cha for quick comparison of the new and old NEMA frame a signment standards.

Raybestos-Manhattan

The Manhattan Rubber Div. of Raybestos-Manhatta Inc., Passaic, N. J., has introduced the Poly-V belt, a sing



Poly-V belt is ribbed lengthwise to mate precisely wi the entire surface of the sheave grooves. Design giv equal horsepower in 1/3 less width, or up to 50% mo horsepower in the same width. It also eliminates th matching problem



Unique design of Poly-V drive gives twice the tractic contact area (heavy line) between belt and sheave comparable V-belt drive

endless rubber belt with a series of parallel V ribs mold lengthwise around the inside circumference.

Westinghouse

The following appointments have been made by Westin house Electric Corp., Pittsburgh, Pa. Walter J. Maythar of San Francisco, Calif., Pacific Coast regional manager f

the Apparatus Div., Dale McFeatters, of Pittsburgh, Pa., director of information services, and Otis O. Rae, of Atlanta, Ga., southeastern regional manager of the Apparatus Div. are elected vice-presidents. E. V. Huggins, of New York, vice-president, corporate affairs, has been named secretary of the corporation.

Westinghouse has issued a catalog (B-5878) containing technical data on industrial Micarta plastic.

Permutit

Permutit Co., New York, N. Y., has completed a $750,000 metal-working plant in Lancaster, Pa., as part of a $1 million expansion program.

Graybar

Graybar Electric Co. has been appointed national distributor of Diamond Power Specialty Corp.'s new line of industrial television equipment.

Hooker

Harris C. Miller has been appointed assistant district sales manager of the New York sales office of Hooker Electrochemical Co., Niagara Falls, N. Y.

Jackson and Church

Homad Services, Ltd., Montreal, Que., has been appointed manufacturers representative in central and eastern Canada for Jackson and Church Co., Saginaw, Mich.

Wallace & Tiernan

Wallace & Tiernan, Inc., Belleville, N. J., has introduced a new chlorinator, the A-701, featuring a dual orifice meter, corrosion-resistant materials, linear flow scale, and automatic control.

American Cyanamid

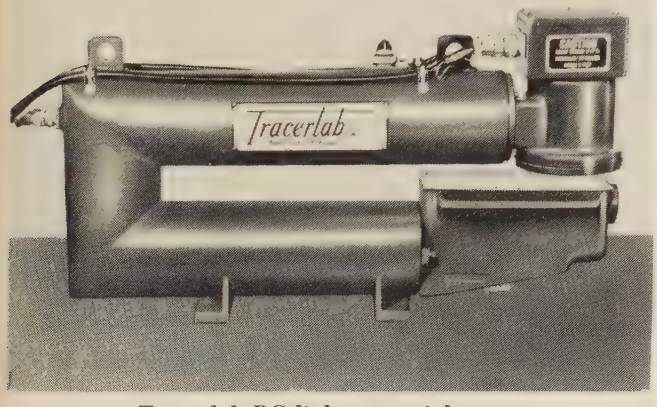
Emil Hladky has been appointed manager of American Cyanamid's new titanium dioxide pigment plant near Savannah, Ga. This will be Cyanamid's largest production facility for titanium dioxide pigment, which the company markets under the trade name Unitane.

Tracerlab

Tracerlab, Inc., 130 High St., Boston 10, Mass., has introduced a new beta gage, the BG Light Materials Gauge, for control of sheet weight, utilizing cesium-137 as a radioactive source.

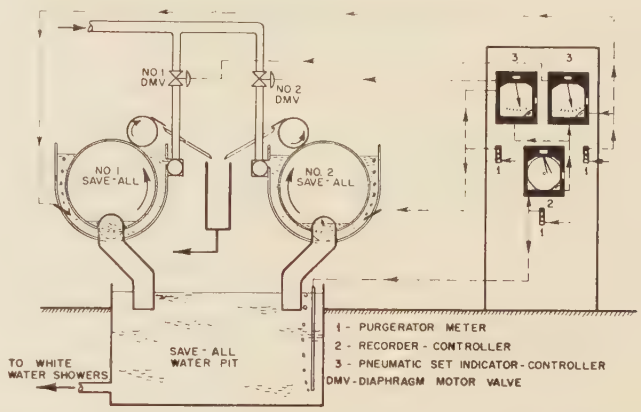
Fischer & Porter

An example of the way in which a bubbler liquid-level controller may be used to save water is the Fischer & Porter saveall water control system at Schmidt and Ault Paper Co., York, Pa.



Tracerlab BG light materials gage

A flow of air is regulated by an F & P Purgerator meter (C-Clamp type meter piped up with constant differential pressure regulator) and is bubbled through a dip tube into the saveall water pit. The depth of water is recorded on a direct-reading chart of the indicating-recording controller which senses the depth of water in the pit by the bubbler back-pressure exerted on a sensitive bellows. This controller then automatically adjusts the set point of two indicating controllers, each with a similar air bubbler system in the saveall machines. Each of these controllers then sends a pneumatic signal to a diaphragm motor control valve in the supply line of its saveall machine. The flow of water and pulp to each saveall machine is therefore governed by two



Schematic diagram of the saveall system at Schmidt & Ault Paper Co., York, Pa. The recorder-controller (2) senses the water level in the saveall pit and pneumatically adjusts the set-point of the indicator-controllers (3) which control the feed to the saveall machines

controlled variables: (1) the demand for water from the saveall pit, and (2) the demand for water in each saveall machine. The water level in both the saveall machines is maintained even if the screen of one or the other machine should become temporarily clogged.

The dip tube in the saveall pit is suspended 12 in. above the zero level and control point is 4 ft. $5^1/_2$ in. above zero level. The instrument has a range of 0 to 8 ft. permitting control over a considerable range of water demand.

The indicating controllers for the two saveall machines have adjustable stops (adjustment can be made with a screwdriver) so that the valves in the supply lines will not close entirely in the event of very low water demand from the saveall pit. Thus, a small flow of water will be retained in the save-all machines to prevent clogging of the screens. Overflow from the saveall pit would then be by-passed to another system. The indicating controllers have a range of 0 to 50 in. of water but are adjusted to a shorter span within this range.

This system achieves: (1) automatic control of the water level in the saveall pit regardless of demand, (2) automatic control of the water level in each of the two saveall machines, (3) the operator can now turn his attention to other duties, (4) excessive demands for shower water from the saveall pit will not deplete the supply, (5) maximum efficiency of water use is achieved without waste, (6) automatic control contributes to close integration of the operation with the mill system as a whole.

Pennsalt

William A. LaLande, Jr., and Edward F. Beale have been elected vice-presidents of Pennsylvania Salt Mfg. Co., Philadelphia, Pa. William P. Drake has been named president of the new Industrial Chemicals Div. of the company. Joseph S. McCulloch has been appointed manufacturer's representative of the company's Corrosion Engineering Products Dept.

A-C

R. C. Allen has been appointed director of mechanical engineering of the General Machinery Div. of Allis-Chalmers Mfg. Co., Milwaukee, Wis. L. J. Linde has been appointed director of electrical engineering for the division. O. V. Tally has been made director of industrial sales, J. S. Morgan director of utility sales, and W. L. Manly director of general-purpose equipment sales. A new northwest region has been formed under M. M. York. J. H. Burrus, Jr. is now manager of the midwest region, and John E. Smet is manager of the New England region.

Chempro

Chemical and Power Products, Inc., 11 Broadway, New York, N. Y., is supplying pure Teflon sheets in a variety of standard sizes.

Ebasco

John J. Reilly has been appointed chief appraisal engineer of Ebasco Services, Inc., replacing W. M. Black, who has been appointed consulting appraisal engineer.

Azco

Azco, Inc., Appleton, Wis., has formed a subsidiary, Azco Fire Protection, Inc., to furnish fire protection installations to pulp and paper mills. Raymond C. Max is president of the new organization.

Cleaver-Brooks

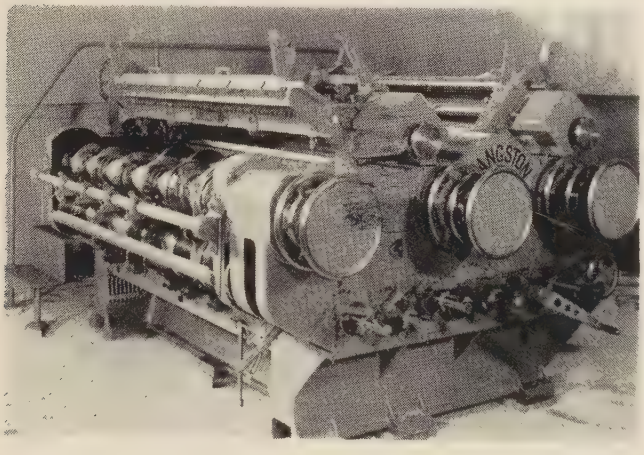
Cleaver-Brooks Co., Milwaukee, Wis., has published a bulletin (AD-134) introducing the new "CB" line of small boilers (15 to 40 hp.).

International Nickel

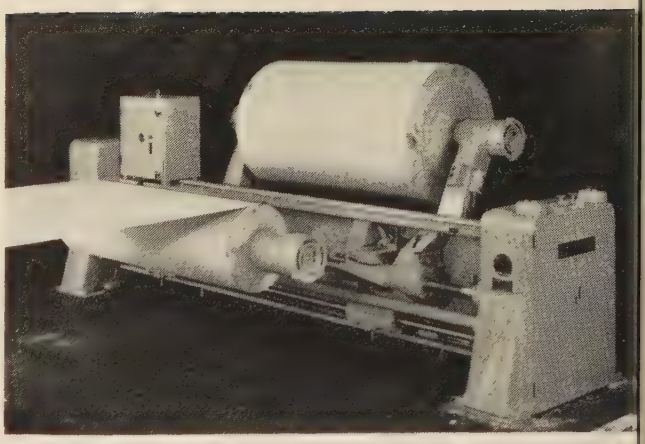
International Nickel Co., 67 Wall St., New York, N. Y., has issued a bulletin (A-141) on heat-resistant alloys in cast form.

Langston

Samuel M. Langston Co., Camden, N. J., has redesigned its 32 by 73-in. printer slotter for greater operating speed, more accurate printing, and simplified servicing and maintenance. The first model of the new series was shipped to Hinde & Dauch Co., Baltimore, Md.



Greater operating speed, more accurate printing and simplified servicing and maintenance have been built into the new Special VL 32 by 73-in. printer-slotter, last of five models to be redesigned by the Samuel M. Langston Co., Camden, N. J. The 15-ton unit, smallest of the Langston family of printer-slotters, takes blanks of corrugated board up to 32 by 73 in. and prints, slots and scores them prior to final assembly into a finished corrugated container. Rated top speed of the new unit is 300 blanks per min.



In the latest step in its current expansion program, th Samuel M. Langston Co., Camden, has subcontracte the manufacture of its shaftless mill roll stands—o initial $480,000 order—to the Fayscott Co., Dexter, M The order placed by Langston, leading maker of corrugate board and box making machinery, calls initially for th manufacture of 45 stands. The move, part of an overa program to boost Langston's production by 45%, is e pected to cut by almost one-third the delivery time of the machines. The shaftless mill roll stand picks up ar automatically positions heavy rolls of paperboard lin and corrugating medium and feeds them in a continuo web into the corrugating machines

Foxboro

The Foxboro Co., Foxboro, Mass., is building a bran factory at San Leandro, Calif.

Industrial Nucleonics

Industrial Nucleonics Corp., Columbus, Ohio, has d veloped a new beta radiation gage, Model S, priced to s

Model S gage with recorder

under $3500, for continuous process industries where produ tion rate is low or where production is intermittent.

G.E.

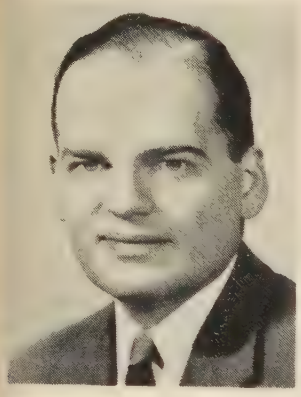
General Electric Co., Schenectady, N. Y., has published bulletin (GED-2100) announcing a new line of recording co trollers designed for continuous measurement and conti uninterrupted by periodic standardization. Also announc by G.E. is a new portable hand tachometer featuring a sca chaining device which reduces misreading of its vario ranges.

Monsanto

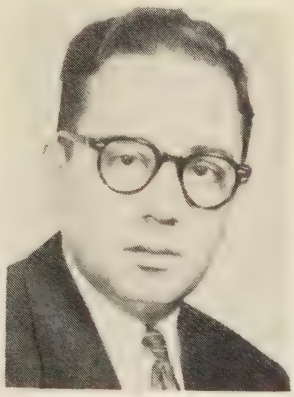
Monsanto Chemical Co., Springfield, Mass., has develop a stir-in type vinyl paste resin, Opalon 410, which can be us for textile and paper coatings, slush molding, and dripping.

National Starch

James Dillon has been elected vice-president of National



James Dillon



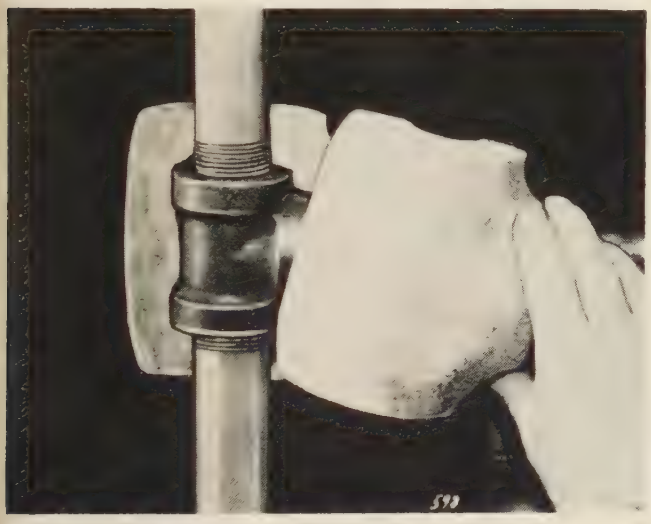
S. A. Segal

National Starch Products Inc.

Starch Products, Inc., New York, N. Y. S. A. Segal has succeeded Mr. Dillon as secretary.

Fiberglas

Owens-Corning Fiberglas Corp., Toledo 1, Ohio, has introduced a molded pipe-fitting insulation for rapid installation on hot and cold line fittings.



Manufactured in accurately preformed halves, Fiberglas molded pipe-fitting insulation is light in weight, easy to apply, provides an attractive appearance, and has long life. The two halves may be stapled, wired, or taped together for permanent or removable attachment

Also newly introduced is Fiberglas Acoustical Form Board for poured-in-place gypsum roof decks.

OBITUARIES

Russell C. Shearer

Russell C. Shearer, 50, general manager of The Racquette River Paper Co., died suddenly on April 17, while on a fishing trip in the forest preserve of the company in the Adirondacks. Funeral services were held Tuesday, April 20, from the Shearer home at Raymondville, N. Y., with burial in Lake View Cemetery, Skaneateles, N. Y. He is survived by his widow and a five-year-old daughter, Gretchen.

Russell Clarence Shearer was born in Kylertown, Pa., Oct. 27, 1903. He graduated from The New York State College of Forestry at Syracuse, N. Y., in 1933, and served with the U. S. Forest Service until 1938.

He joined the St. Regis Paper Co. in 1938, and worked up to the position of mill manager at Norfolk, N. Y. Leaving St. Regis in 1945, he joined the Alliance Div. of The Howard Smith Paper Mills as general manager. Here he served from 1945 to 1952, inclusive.

On May 1, 1953, he joined The Racquette River Paper Co., Potsdam, N. Y., as general manager.

Mr. Shearer became a member of The Technical Association of the Pulp and Paper Industry in 1947.

Lorne Campbell Anderson

Lorne C. Anderson, assistant to the president in charge of research and development of the Ontario Paper Co. Ltd., Thorold, Ont., died suddenly of a heart attack in a hospital in St. Catherines, Ont. He was ill for some time.

Mr. Anderson was born in Victoria Harbor, Ont., on Nov. 7, 1895, and graduated as a chemical engineer from Queens University in 1923.

From 1923 until 1930 he was chemist, sulphite superintendent, and assistant manager of manufacture for the St. Lawrence Paper Co. in Three Rivers, P. Q. He joined the Ontario Paper Co. organization in 1930 as control superintendent. In 1934 he became manager of manufacture.

Mr. Anderson was a member of the Technical Association of the Pulp and Paper Industry in 1935. He served a three-year term as a member of the TAPPI Executive Committee and was a past-chairman of the Technical Section of the Canadian Pulp & Paper Association.

James P. Rubush

James Prosser Rubush, West Coast representative of Improved Machinery, Inc., died suddenly in his sleep in a Portland, Ore., hotel on March 26, 1954. His home was in Wenatchee, Wash., where he owned and operated three fruit ranches.

Mr. Rubush was born in Edinburg, Ind., on June 24, 1905, and attended the U. S. Naval Academy at Annapolis, Md.

His experience in industry included employment by the Rhinelander Paper Co., Rhinelander, Wis., Procter & Gamble Co., Ivorydale, Ohio, Central Paper Co., Muskegon, Mich., Filer Fibre Co., Manistee, Mich., Swenson Evaporator Co., Harvey, Ill., Goslin-Birmingham, Inc., Birmingham, Ala., John Inglis Co., Ltd., Toronto, Ont. He also operated as a consultant in the application of evaporation processes until 1947 when he went to Wenatchee.

He is survived by his widow, the former Virginia M. McCutchan of Longview, Wash., and two daughters.

Mr. Rubush has been a member of the Technical Association of the Pulp and Paper Industry since 1938.

Ernest Parish Cook

Ernest P. Cook, assistant chief engineer, Brown Co., Berlin, N. H., died at the St. Louis Hospital, Berlin, N. H., on May 10, 1954.

Mr. Cook was born at Fort Edward, N. Y., on April 9, 1890. For the past 42 years he was employed by the Brown Co. where his contributions to the company were outstanding. These contributions included many machinery and equipment inventions, one of which was the IMPCO heavy stock pump.

He is survived by his wife, a daughter, a son, and a granddaughter.

TAPPI DIVISIONS AND COMMITTEES

Reports of Activities

Semichemical Pulping Committee

J. N. McGovern, chairman, has announced the following personnel of the Semichemical Pulping Committee:

J. N. McGovern, Chairman, Parsons & Whittemore, Inc., New York, N. Y.
C. W. Converse, Secretary, Sprout, Waldron & Co., Inc., Muncy, Pa.
R. W. Brown, Hammermill Paper Co., Erie, Pa.
W. T. Butler, Abitibi Power & Paper Co., Ltd., Sault Ste. Marie, Ont., Canada
E. D. Cann, Howard Smith Paper Mills, Ltd., Cornwall, Ont., Canada
R. G. Coker, Sonoco Products Co., Hartsville, S. C.
P. L. Gilmont, Crossett Paper Co., Crossett, Ark.
J. S. Hart, Pulp & Paper Research Institute of Canada, Montreal 2, P. Q., Canada
Gerald Haywood, West Virginia Pulp & Paper Co., Luke, Md.
G. G. Kimble, Union Bag & Paper Corp., Savannah, Ga.
R. G. Knecktges, American Box Board Co., Filer City, Mich.
D. J. MacLaurin, Institute of Paper Chemistry, Appleton, Wis.
W. W. Marteny, National Container Corp., Tomahawk, Wis.
G. W. Mead II, Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.
J. E. Sapp, Gaylord Container Corp., Bogalusa, La.
E. H. Shriver, The Mead Corp., Chillicothe, Ohio
J. A. Staidl, Camp Manufacturing Co., Franklin, Va.
D. G. Terry, The Mead Corp., Chillicothe, Ohio
C. K. Textor, The Bauer Brothers Co., Springfield, Ohio
S. A. Woodruff, Battelle Memorial Institute, Columbus, Ohio

Equipment Survey Subcommittee

J. E. Sapp, Chairman
R. G. Coker
D. J. MacLaurin
J. A. Staidl
D. G. Terry

Semichemical Pulping Measures Subcommittee

R. W. Brown, Chairman
W. T. Butler
E. D. Cann
J. S. Hart
G. C. Kimble
R. G. Knechtges
G. W. Mead, II

Standard Terms Subcommittee

P. L. Gilmont
Gerald Haywood
W. W. Marteny
C. K. Textor

Bibliography and Review Subcommittee

J. N. McGovern, Chairman
S. A. Woodruff

News Note Subcommittee

C. W. Converse, Chairman

The annual meeting of the committee was held at 2:00 p.m., Feb. 15, 1954, under the chairmanship of J. N. McGovern, with the following present:

J. N. McGovern,* Parsons & Whittemore, Inc.
S. A. Woodruff,* Battelle Memorial Institute
E. D. Cann,* Howard Smith Paper Mills, Ltd.
S. R. Parsons, Consolidated Water Power & Paper Co.
E. H. Cumpston, E. R. Jones & Sons Co.
P. L. Gilmont,* Crosset Paper Co.
C. K. Textor,* The Bauer Brothers Co.
W. W. Marteny, National Container Corp.
J. E. Copenhaver, Sonoco Products Co.
J. E. Sapp,* Gaylord Container Corp.
J. A. Staidl,* Camp Mfg. Co.
D. W. Libby, Robert Gair Co., Inc.
T. W. Small, Sprout, Waldron & Co., Inc.
C. N. Rogers, Sonoco Products Co.
K. E. Bradway, Camp Mfg. Co.
W. T. Butler,* Abitibi Power & Paper Co.
R. E. Collins, Sprout, Waldron & Co., Inc.
R. W. Brown,* Hammermill Paper Co.
J. J. Owen, Union Bag & Paper Corp.
J. S. Hart,* Pulp & Paper Research Institute of Canada
D. J. MacLaurin,* Institute of Paper Chemistry
W. K. Voss, Ontario Paper Co., Ltd.
C. W. Thing, Brown Co.
D. B. Kuhe, Crossett Paper Mills
J. C. Hair, Crossett Paper Mills
E. Beauvais, American Box Board Co.
G. A. Balko, Richmond Pulp & Paper Co., Ltd.
C. W. Converse,* Sprout, Waldron & Co., Inc.

* Semichemical Pulping Committee Member.

The minutes of the previous meeting, Sept. 14, 1953, circulated to the committee members prior to the meeting by the secretary, C. W. Converse, were accepted.

Subcommittee reports were received as follows:

Equipment Survey (J. E. Sapp, Subcommittee Chairman): The equipment survey has been completed, including the tabulation of the results. Replies were received representing 20 mills out of 26 contacted, an excellent response. The survey will be ready for publication very soon.

Semichemical Pulping Measures (R. W. Brown, Subcommittee Chairman): The pulping measures questionnaire was sent out with the equipment questionnaire. Replies were received from 17 mills out of 26. A report on the replies was presented at the technical session on Wednesday, February 17, and will be published later. A brief summary of the replies was distributed to the committee members.

Mr. Brown referred the committee members to the paper "Establishment of Correlations for the Three-Stage Bleaching of Semichemical and Sulphite Pulps and Blends, Employing a Modified Permanganate Method," by P. L. Leemhuis published in *Tappi*, January, 1954. This is the complete paper, the elements of which were presented at the 1953 annual meeting by R. H. Rasch as "Bleachability Test for High Yield Pulp."

Mr. Brown then requested discussion on the following question: "Should the method of measuring cooking degree correlate with the lignin content of the pulp or with the chlorine required to reach a given brightness?"

J. S. Hart pointed out that lignin in pulp is not necessarily a measure of fiberizing power requirement and asked if the measure should apply to both board grade pulp and bleachable pulp.

D. J. MacLaurin pointed out that there are two measures needed: (1) a measure suitable for mill control; (2) a measure for bleachability.

Mr. Brown remarked that up to yields of 70% of pulp from hardwoods the permanganate number measure predicts the chlorine requirements for bleaching with reasonable accuracy. Above a yield of 70%, the results obtained by the permanganate number determination vary considerably with the degree to which the hardwood neutral sulphite semichemical pulp has been fiberized. A given pulp will have a higher apparent permanganate number if it has been completely fiberized than if it is partly fiberized and still contains coarse fiber aggregates.

J. S. Hart replied that there is not a straight line relationship between permanganate number and chlorine demand and therefore, the chlorine number determination is possibly a more correct measure.

J. N. McGovern commented that permanganate number is not suitable for higher yield pulps. A better test must be developed.

J. S. Hart proposed the use of the Roe chlorine number test, stating that an accurate test can be made on 20 to 25 minutes and a routine test in considerably less time. He undertook to provide members of the subcommittee with copies of the procedure for the test as made by the Pulp & Paper Research Institute of Canada.

Mr. Brown then inquired if his subcommittee should seek a cooking degree universally applicable to any yield range or should develop one test for bleachable grades and another test for board grade pulps.

D. J. MacLaurin pointed out that in general what is required is a measure which is reproducible, not too difficult for control use, or too slow, and which will correlate with useful characteristics of the pulp. Nothing is yet available for this purpose with usefulness is compared to that of the permanganate number used with fully cooked pulps.

J. S. Hart reported on the progress of the cohesive rating, a measure of fiberizing power requirements as follows: this is a measure of the force with which fibers stick together after cooking. Regardless of the lignin content, the measure predicts the fiberizing power required. It is hoped that this work will be completed by May and that a paper may be presented on the subject next year.

Standard Terms (C. K. Textor, Subcommittee Chairman): Mr. Textor submitted a tabulation of results of the recent ballot on standard terms to the committee members. It is planned to submit these terms that received 75% of the votes to the higher committees for consideration; the others will be further revised. Discussion was requested on the terms that failed approval in order to reconcile the differences.

D. J. MacLaurin recommended that the subcommittee delay submission of any of the terms until the subcommittee considered them again. The terms should be drawn up in a consistent form. The next submission will be final. Those terms that have received 75% votes will be put in the same form but will not be resubmitted. P. L. Gilmont offered to revise and harmonize the definitions in accordance with the recommendations of the full committee. These definitions will be submitted to the committee in the near future. J. S. Hart moved that those terms receiving a $^3/_4$ vote be resubmitted to the committee. The motion was seconded by D. J. MacLaurin. Carried unanimously. D. J. MacLaurin moved that for the time being the committee will not consider chemigroundwood within its scope. This motion was seconded and carried unanimously.

C. W. Converse recommended that the definition of acid sulphite semichemical pulping be reconciled with the standard terms for the sulphite process.

P. L. Gilmont recommended that the definition of kraft semichemical pulping be reconciled with the standard terms for the sulphate process.

Newsnote (C. W. Converse, Subcommittee Chairman): The newsnote is the round table for committee discussion when the members are not together.

Bibliography and Review (J. N. McGovern, Subcommittee Chairman): Mr. McGovern reported that no action has been taken on the request to TAPPI for a grant to enable The Institute of Paper Chemistry to bring its annotated bibliography on semichemical pulping up-to-date.

The committee would like to provide translations of interesting foreign articles. A problem exists in having the translations reproduced.

D. J. MacLaurin suggested that they be printed in the A section of *Tappi* magazine. The committee secretary will obtain reprints for distribution to the committee members.

S. D. Woodruff offered the services of his institute on a small scale.

The committee agreed that there is interest in translations of foreign articles.

This completed the subcommittee reports.

The meeting turned to new business. The possibility of a Summer committee meeting was discussed at length. One suggestion was that it be held with the Alkaline Pulping meeting. It was agreed that technical papers must be presented for discussion in order to make attendance at the meeting justifiable to the companies.

The plans for the 1955 annual meeting were discussed. Several papers were offered or suggested.

Mr. McGovern asked for suggestions on committee-sponsored research, suggesting a study of the kinetics of the sodium bisulphite process.

D. J. MacLaurin recommended studies of phase equilibria of the cooking chemicals.

Mr. Copenhaver suggested a study of the precipitation of calcium oxalate from neutral sulphite bleach liquor.

D. J. MacLaurin suggested that there are many important problems for study in the field of semichemical pulp bleaching.

Mr. Cann suggested consideration of chemical recovery problems in semichemicol pulping.

J. M. McGovern, *Chairman*
C. W. Converse, *Secretary*

Pulp Testing Committee

The meeting of the Pulp Testing Committee of TAPPI held on March 18, 1954, in Portland, Ore., was called to order in the Multnomah Hotel at 2:30 p.m. by Chairman Frank Caskey. Members in attendance were Otto Sangder, Elmer Christopherson, and Alfred Graef.

The minutes were read of the TAPPI Pulp Testing Committee meeting held in New York, Feb. 15, 1954. Mr. Caskey then told of some of the other meetings which he had attended in New York. He mentioned particularly that there would be a Divisional Testing Committee meeting sometime in November, 1954, probably to be held in Ohio. He said that it was proposed that papers would be presented on the applications of such techniques as are not ordinarily found in the member pulp and paper mills. Such equipment would be discussed as spectrophotometers, electron microscope, and such techniques as chromatography.

A discussion followed covering several topics in detail which were brought up in the National TAPPI meeting. Of especial interest was the discussion on the sheet size of the standard pulp testing sheet. F. A. Delforge of the Robert Gair Co. had reported at National TAPPI that he was experimenting with a larger sheet mold and that he would be able to report at a later date more in detail as to what success he had experienced with this equipment. The old problem of consistency determination was again brought up. It was agreed that while everybody has some method in present use which determines consistency, it is quite likely that in many cases these methods could no longer be regarded as applicable to a standard procedure, probably because of the custom-built equipment and very peculiar techniques used for each certain mill. The above discussion brought out the possibility that it might be a good practice to call upon all members of the Pulp Testing Committee to work on some one particular phase of pulp testing that is of particular concern to their company. By doing this it would give all of the members a chance to actively contribute something to the continuing proceedings.

Mr. Caskey stated that the Statistics Committee of TAPPI was to do work on the data gathered by our committee on dirt count as part of a course in statistics at the University of Maine.

It was announced that ballots would be mailed to the membership to cover two specific items. The first was to determine whether the use of aluminum foil would be acceptable as a reference standard to check mullen testers. The second was to revise a portion of standard procedure T 205 m-53, which has received some criticism, and which states: "To

duplicate as far as possible except for the consistency of the stock the average conditions under which pulp is commercially made into paper." The above appears in the second paragraph of the standard procedure. It was proposed that this paragraph should read something like the following: "The method has been drafted with the object of providing an accurate method with which any existing pulp testing method may be compared so as to obtain factors to convert the test figures to standard results having an international significance."

It was decided that the standard procedure T 219 concerning the bleach requirement of pulp would not be further considered at this time. The reason being that while the method may not be in widespread use at the present time, there may be some mills employing it. However, it was recognized that this particular procedure is no longer used widely to determine the bleach requirement of pulp.

In an additional discussion upon the possibility of parcelin out various problems to other members of the committee, i was suggested that it may be in order to send out letters t members of the committee to have them suggest method which they believe require some revision or modification.

The meeting was adjourned at 4:30 p.m. with the an nouncement that the last meeting until fall is scheduled fo May during the Pacific Section meeting at Gearhart.

AL GRAEF, *Acting Secretary*

Preparation of Papermaking Materials Committee

Subcommittee on the Significance of Sizing

A meeting was held at the Hotel Bond, Hartford, Conn March 19, 1954. Those present were:

F. S. Klein, Byron Weston Co., Dalton Mass.
J. C. Barthel, American Cyanami Corp., New York, N. Y.
T. F. Morse, Hercules Powder Co Wilmington Del.
N. H. Keeney, Jr., Lowell Technologica Institute, Lowell, Mass.
J. T. Loomer, Robert Gair Co., Ne York, N. Y.
P. L. Haggerty, George LaMonte & Son Nutley, N. J.

A decision at previous meetings ha been to proceed with plans for a que tionnaire which would find out some the unknowns in testing sizing and th significance of the test results. In orde to supplement plans already made an to speed up the work, it was decided t develop a special questionnaire and mak a special survey of a small segment the total industry, namely, the writin paper industry. The plan as outlined i this meeting is to survey a represent tive list of paper mills to determine h they test sizing and writability of writ ing papers. It is proposed to obtai from a group of papermakers, possibl 12, samples of 20-lb. bond paper repre senting three degrees of sizing of writ ability. Presumably some of these wi be slack sized and some too hard sized These will be coded and sent to approxi mately 20 representative mills produc ing writing paper and to the Lowe Technological Institute. These mill will be asked to judge the papers b their standard techniques for sizing an also for writability.

Mr. Bainbridge will prepare a roug draft of a letter which might accompan the samples of paper, requesting th work by the paper mill. Messrs. Morse Barthel, and Bainbridge will draw up list of representative mills and individ uals. TAPPI headquarters will b asked to assist in obtaining these sam ples of paper and in handling the send ing out of the questionnaires. In thi way the samples and results will be kep confidential. It is hoped the results o a survey of this nature on writing paper will clarify the problems in order to as sist in similar investigations of othe types of paper.

JOHN P. BAINBRIDGE, JR., *Secretary*

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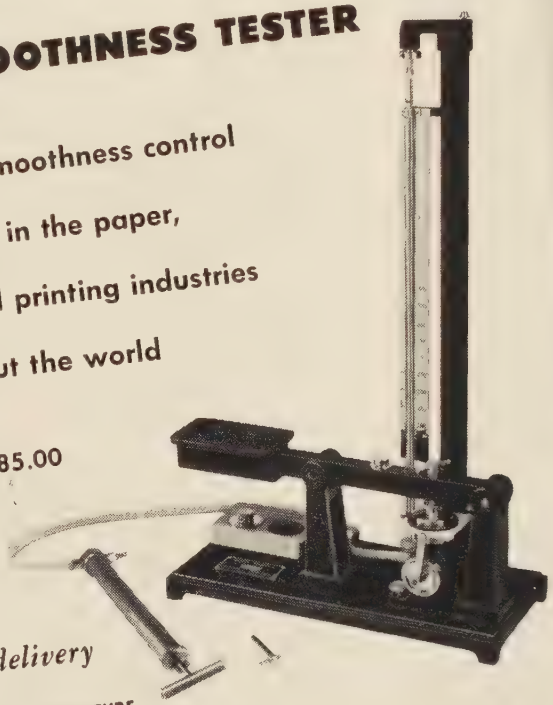

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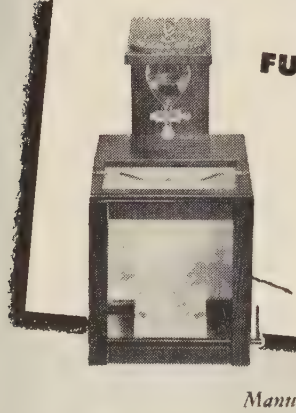

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LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel, and Events

Lake Erie

The speaker at the April 16th meeting of the Lake Erie Section of the Technical Association of the Pulp and Paper Industry was R. L. Lewis of the Ohio Boxboard Co. Mr. Lewis's paper follows:

New Developments in Converting Paper and Board

R. L. Lewis

THE pulp and paper industry is now the fifth largest industry in this country. One of the chief reasons for the continued growth of our industry lies in the fact that paper and paperboard are suitable for so many end uses. We use paper and paperboard either alone or combined and modified for new uses we would not dream of only a few years ago. Per capita use of paper and paperboard products has increased in the past 50 odd years from 58 lb. a year to about 400 lb. per person today. We certainly must recognize that development of new products has accounted for a substantial portion of the increased usage.

Paper and paperboard used to be principally fiber. As your speaker last month, Mr. Markee, brought out so well, paper products today made from fiber alone are rare. As we develop combinations of paper fiber and chemicals, we also develop new possible end uses. Paper-foil combinations, resin impregnations, waxes, coatings of various types, are all examples of such combinations.

If we can assume that continued growth in the use of paper and paperboard depends to a large extent on development of new or improved paper products, we as technical people may benefit from a review of some current developments.

New methods of merchandising the food we eat has brought many food stuffs to the shelves of the modern supermarket in folding cartons. We have all seen the detergent carton which has built in moisture vapor protection using asphalt or microcrystalline wax barriers. You see here examples of paper milk bottles, cookie cartons that provide greaseproof protection, and windowed doughnut cartons. All these have been developed to not only protect the product but make it into a silent salesman. Ten years ago we had no paper milk bottles. Today, over half the milk sold is in paper containers. Fruit juice and other beverages are taking advantage of the lightweight, disposable properties of paperboard.

One of the problems faced by the shipper is maximum damage protection with minimum weight. The fiber box has rapidly replaced wood for this reason. Eighty-five per cent of our nation's packaged freight is shipped in corrugated and solid fiber boxes. Gross weights up to 300 lb. are now being packed in recently developed containers. We now carry everything from apples to washing machines in fiber boxes. Special containers, such as the sulphur impregnated and V boxes, have opened up many new uses where high humidities or other extremes of climate make the job of protecting the product more difficult. We have all seen the increased use of fiber boxes for fresh fruit and vegetables. Practically the whole 1953 lemon crop on the coast moved in corrugated. Vacuum cooling makes it unnecessary to top-ice railway cars so the lettuce packers are rapidly swinging over to corrugated: 60 to 65% of the lettuce from the coast moved last year in corrugated. Beer retrippers and corrugated hardware kegs are replacing wood very satisfactorily. Honeycomb made from resin impregnated medium is a new development. This material is used to provide cushioning, sound deadening, and strength for such things as car lining, interior packing, pallets, and plywood door cores.

We would like next to mention briefly some of the additives to paper and paperboard that have led to wider uses. Wet-strength resins and other resin and latex additives have made possible insulating papers, condenser paper, paper printing plates, paper diapers, synthetic leather, masking tape, gaskets, and shoe findings. Resins impart dimensional stability for map papers and structural panels.

The tissue and toweling field has developed many new uses. Industrial wipers, paper toweling napkins, facial tissues—all are finding wider use. Just a simple thing like blowing your nose is no longer what it was due to paper tissue developments.

Coating is not really a new process, however, various coatings have transformed paper and paperboard into products with a multitude of new uses both decorative and functional. Better printing surfaces, greaseproofness, moisture vapor protection name but a few. Polyethylene, cellulose, vinyl, and silicone resins have been used for many special properties such as locker papers, heat sealing and release coatings.

Moldproof paper and paperboard has been developed for packing fruit and soap products. Insect and rodent repellent paper and paperboard is a must in packaging certain food products. Rust inhibitor treated paper is making it possible to package and ship ferrous metal parts without costly greasing operations. Copper and brass articles such as shotgun shells and copper ware are packaged in special tarnish-free paperboard.

Fire-retardant papers and boards are used for decorations, matchstick board, wallboard, and acoustical tile.

G. H. Chidester, chief of the Pulp and Paper Div. of the Forest Products Laboratory, stated in a recent article that few people realize that a very substantial house could be built and furnished entirely with paper products. Armchairs cut from corrugated board covered with fabric are already being marketed. Paper rugs, curtains, draperies, window shades, lamp shades, and wallpaper could help furnish the room. Paper-covered plywood with honeycombed cores have made durable sturdy houses without framing.

We all have seen tape for corrugated boxes made using glass fiber reinforcement. Combinations of organic and inorganic fibers may give new properties that will be useful.

We could probably talk for several more hours on the subject, however, because paper and paperboard is such a versatile material, it would be impossible to mention all of its varied uses. We have only skimmed the surface and have attempted to tell you about and show you some of the more common developments.

In closing let me say that we are all this very minute engaging in a development program which will affect the future of our industry. Probably the most important development is the development of our people who in turn transform ideas into finished products. Many factors will influence our future growth but surely it goes without saying that forward growth means development of new and improved products made from paper and paperboard.

R. L. LEWIS, Ohio Boxboard Co., Rittman, Ohio.

Lake States

The fifth meeting of the year consisted of an afternoon and evening program held at Madison, Wis., on April 13, 1954, with an attendance of about 80. The afternoon program consisted of a visit to the Forest Products Laboratory. During the visit much of the Laboratory's research equipment was seen, and discussions were given by members of the Laboratory staff on subjects such as: the use of chromatographic analysis in studying the carbohydrates present in pulps, the use of paper laminates in improving lumber quality, and the improvement of pulpwood stands through forest genetics.

The evening program was held at the Hotel Loraine. Following the dinner a speech was given by Farrington Daniels, chairman of the Chemistry Department at the University of Wisconsin. Mr. Daniels delivered a very interesting talk on the subject of solar energy. He discussed our tremendous uses of energy and the possibility of meeting these requirements by use of solar energy when the world's supplies of coal, petroleum, and natural gas are exhausted.

S. R. Parsons, *Secretary*

Empire State (Metropolitan District)

About 135 members and guests were present at a joint meeting, held on April 13 at Fraunces Tavern in New York City, of the Metropolitan District Empire States Section of TAPPI and the New York Council of ASTM.

R. G. Macdonald, R. T. Bingham, and A. J. Winchester were present representing the National TAPPI organization, while J. S. Pettibone and L. C. Gilbert were present representing the National ASTM organization.

The nominating committee headed by P. L. Haggerty submitted the following slate of new officers for the Metropolitan District Empire State Section of TAPPI: Chairman, J. C. Rice; Vice-chairman, L. R. Ayers; Secretary-treasurer, J. H. Doherty.

The entire slate was elected by the unanimous vote of the group. Continuing as members at large of the Executive Committee will also be A. V. Arenander and W. T. Cusack.

Acting as program chairman for this meeting was E. R. Thomas, who introduced the speakers for the evening. Although W. A. Del Mar, chief engineer of Phelps Dodge Copper Products Corp., Habirshaw Div., was scheduled to speak, he was unable to attend, and E. J. Merrill, director of the Electrical Research Laboratory for the same company, read the paper prepared by Mr. Del Mar. The subject of the paper was "The Desired Electrical Qualities of High Voltage Cable Paper." Mr. Del Mar's paper is printed below.

Mr. Merrill was followed by C. J. Krogel of Western Electric Co. Mr. Krogel discussed the use of paper as an insulating material for conductors in telephone communication cable. After a short discussion of the subject company he showe sound movies entitled "Voices in Paper." This showed ho the old method of winding paper around wire has been r placed by the "pulp insulation process" in which the wire actually passed through a vat containing pulp and coate with fiber in a process similar to making paper on a cylind machine. Fourdrinier machine wet ends have also bee adapted and are in use. The wire embedded in a ribbon pulp is "polished" to convert the ribbon to a continuous tub which is dried at high temperatures and treated to give th desired insulating and other electrical properties. Finall the wires are twisted into pairs and stranded into bundles 100 pairs each which are stranded into the final cables co taining 2100 pairs or 4200 separate conductors. The movie also showed the new process for covering the outside of th completed cable with aluminum and polyethylene to repla lead sheathing.

Both papers were followed by an interesting discussio period with particular emphasis being made by the cabl manufacturers present on the importance of containing bett paper for cable insulation.

L. E. Georgevits

The Desired Electrical Qualities of High Voltage Cable Paper

W. A. Del Mar

Anyone who has seen an impulse generator discharg a million volts across a 5-ft. gap, must pause to wonder at th ability of less than 1 in. of oil impregnated paper to with stand repeated shocks of that voltage.

Neither paper nor oil will perform this wonder. It is th combination of the two, whereby the effective thickness the oil layer is increased by its tortuous passage through th paper, and its turbulent ions balked by collision with th cellulose fibers, which gives impregnated paper this ex traordinary property.

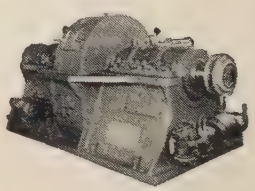
Let us consider what has been done to take the greates advantage of this material and what possible steps may b taken in the future for its enhancement.

Being an electrical engineer, not connected in any way w t paper manufacture, your chairman has placed me in a some what invidious position in asking me to address a group people who are experts in the field of paper technology. How ever, it is possible that the user of paper may be taking a loo into the future in a way that is foreign to the thoughts of thos engaged in manufacture. I shall begin by quoting from th minutes of a recent meeting of the Insulated Conductor Committee of the American Institute of Electrical Engineers

"One of the first problems under investigation is to determin

W. A. Del Mar, Chief Engineer, Phelps Dodge Copper Products Corp Habirshaw Div., Habirshaw, N. Y.

proven by performance



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what the carrying capacity of a pipe-type paper insulated cable would be at voltages up to 350 kv. So far, the indications are that there will be serious limitations, unless a power factor lower than that normally obtaining for oil impregnated paper can be attained and can be relied upon to remain essentially constant throughout a long service life of such a cable. It seems that with the trend toward still higher voltage cables, the possibility that may now or in the future be offered by synthetic films to successfully replace paper insulation for such extra high voltage cables should be carefully investigated. A very interesting discussion ensued in this connection in which it was pointed out that there is nothing available in such films at this time to fulfill the requirements, but also that there is some active thought in some quarters being given to this problem with the prediction that within 10 years extra high voltage cables utilizing such films will be commercially available."

I might add to that the fact that when I was in Europe, in 1952, I saw some interesting work in progress along these lines, both in Germany and in France. If synthetic films find their way into extra high-voltage cables, it will not be long before they find their way into the great bulk of cables of medium voltages. The paper industry should not delay in preparing to meet this competition. I shall return to this subject later.

For the benefit of those who may read this paper but are not paper specialists, I ask you indulgence if I say a few elementary things about cable paper manufacture. Please correct me if I make any mistakes.

The pulp for cable paper is made in Sweden by sulphate process from spruce which is used because of its fiber length. The imported pulp resembles stiff cardboard. Paper is made by mascerating the pulp in water, depositing it on a wire screen through which the excess water escapes, and subjecting the deposit to successive rolling operations which reduce the mass to the desired dryness, thickness, smoothness, and density. Two types of machines are used, the fourdrinier which operates on a single layer, and the cylinder machine, which may have from two to seven cylindrical wire screens and which rolls together two or more layers of pulp into one thickness of paper.

If paper is viewed against a light, it will be seen to present the appearance of a cloudy sky with relatively clear parts corresponding to the blue sky. These are called windows and the cylinder process, with its superimposed layers, reduces the contrast between windows and clouds.

MANILA ROPE TO WOOD PULP

Until about the end of World War I, cable paper was made from discarded Manila hemp rope. This was then preferred over wood pulp paper because it was better able to withstand the jerks and shears to which it was subjected in the crude taping machines of those days. Used rope, however, became quite scarce toward the end of the war, possibly because so much of it was sent to Davy Jones' Locker by German submarines. Furthermore, the quality of the available paper greatly deteriorated due to the presence of foreign particles and to the efforts of the manufacturers to economize the scarce hemp by making paper of low density, of which more will be said later. It therefore became necessary to find a substitute. Laboratory tests showed that no American wood pulp paper was worth a trial on cable and not much more success was obtained with paper imported from Italy.

Some cable that looked much worse than it really was dated from this period, but a way out was found by making better taping machines and by using paper made in America of wood pulp imported from Sweden.

The Swedish forests from which this pulp was derived are composed of planted spruce trees which are cut at a uniform age, thereby ensuring the utmost uniformity of product. So far as is known, no such practice has been used by producers of American wood pulp. Here is an opportunity which American pulp producers have been slow to embrace.

During World War II the supply of Swedish pulp was jeopardized by a new generation of German submarines. In the intervening years between the two wars, the American pulp industry had done very little to make us independent of foreign supplies. At that time we set up a laboratory papermaking outfit, with miniature testing equipment, to work in collaboration with American manufacturers toward the development of an all-American cable paper. Partly because of the nonuniformity of American pulp, and partly because the Swedish supply never gave out, this attempt was abandoned and Swedish pulp remains the standard for cable paper today. If the present cold war should turn hot, the Swedish pulp supply would be cut off completely. Can we do anything about it now?

PAPER DENSITY

When I entered the cable industry toward the end of World War I, considerable trouble was being experienced with failures on the routine high-voltage test. The men manufacturing cable were sure that the supplier of the impregnant, which was then petrolatum, had done something to spoil their product, a very natural suspicion in view of the fact that the only petrolatum available was that in excess of the requirements of the Cheeseborough Co. to convert into vaseline and offered to the cable companies on a "take it or leave it" basis. Our research department suspected the paper, and in this belief, I spent several days at the mill which supplied our paper, looking over their records and trying to coordinate their manufacturing control test data with failures of cable manufactured with various lots of paper. This, of course, was in the days of Manila rope paper. A new testing device had recently been tried, the Gurley densometer, which measured the permeability of unimpregnated paper to air. This device forces air through a standard area of paper (usually 1 sq. in.) under a pressure of about 567 grams per sq. in. and enables the time for 100 cc. of air to pass through, to be measured. This time, in seconds, is called the Gurley den-

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sity. I found that the paper being supplied to us was of extremely variable Gurley density, ranging from 3 to 18 sec. The paper mill was apparently aiming for low density to economize the precious fiber. I found that the cables that had failed were made from rolls of very low-density paper. We rejected all paper with a density of less than 20 sec. and the epidemic of cable failures stopped.

Gurley density, however, is not only a function of the amount of pulp used, but may also be varied by average fiber size, shape, and range of fiber sizes; also by degree of physical modifications in the processes and by calendering technique used on the paper sheet.

Fortunately, ignorant of these complications, we asked for higher and higher Gurley density and found that we obtained greater dielectric strength with each increment of density, although at a diminishing rate. When we came to use wood pulp paper, we found a density of 350 sec. somewhere near the top of the curve for 60-cycle cable dielectric strength and 4000 sec. for impulse strength.

Then a bomb was dropped on the cable industry by J. B. Whitehead, of Johns Hopkins University, the repercussions of which are hardly over to this day. He showed, by a series of carefully performed tests, that the dielectric strength of small cablelike samples was greater the lower the density of the unimpregnated paper used in their manufacture. He explained this on the basis that the higher the density, the higher the permittivity of the impregnated paper, and therefore the greater the electric stress on the oil in the gap spaces at the edges of the tapes. With rising voltage, on test, the oil would ionize and precipitate failure of the cable.

For some time the discrepancy between Mr. Whitehead's results and those of the manufacturers was not satisfactorily explained. Mr. Whitehead confirmed his findings by additional tests on small samples and the manufacturers confirmed theirs by controlled tests on cables.

Finally the conflict of data was resolved in this way. Where the insulation is thin compared with the size of conductor, as in Mr. Whitehead's laboratory samples, the stress on the oil is practically uniform throughout the thickness of insulation and the Whitehead effect, failure of the oil, occurs throughout the cable. Where, however, the insulation is comparatively thick, as in a high-voltage cable, an ordinary test voltage will ionize and impair only the inner layers of oil and the surrounding layers of un-ionized insulation will resist breakdown better, the higher the density of the paper.

Therefore, the final result is that to obtain high dielectric strength for low-voltage cables (where it is not needed), use low-density paper, but for high-voltage cables, use high-density paper.

There is, unfortunately, a gap in our knowledge of the relation of density to the electrical properties of impregnated paper. Three properties are desirable: (1) high dielectric strength, (2) low permittivity so as to impose a minimum stress on oil films and (3) low power factor.

These three properties are probably functions of sever variables in the manufacture of paper, among which are, u doubtedly, the following: (1) the degree of beating, (2) t density of the deposit of fibers, and (3) the degree of surfa calendering.

It is probable that either increasing or decreasing any o of these variables will influence one or other of the electric characteristics beneficially and, at the same time, be a detr ment to the others. We thus have one of those situatio with which our sciences are continually confronted, whic calls for cooperative research. We are willing to do our par

An important paper by P. Cloke and K. K. Khandelw appeared in No. 3: 309 *Communication and Electronics* (1952 in which the authors tell of testing papers of equal specif gravities but different air resistances and obtaining the rel tion between dielectric strength and air resistance. The found a rising dielectric strength with increasing air resis ance, thus proving the importance of air resistance or Gurle density regardless of specific gravity, for obtaining high diele tric strength.

GRADING BY DENSITY

The Germans were so completely sold on the value of hig density paper that they even patented the use of special pap of very high specific weight. They also patented a cable i which the paper was graded by density, i.e., having hig density paper at the conductor and low-density paper at t sheath, with, if desired, papers of intermediate density b tween them.

Tests of solid-type cables, at the Habirshaw Laboratorie made with two grades of paper of widely different densitie arranged as specified in the patent, failed to show the expecte advantage. The reason was found with the aid of a devic for measuring tape tensions in a finished cable and later co firmed by polystyrene embedded wafers of thin cable cro sections which showed a paper-free region at the junction the two grades of paper (*1*). It was surmised either that t more dense paper had shrunk in drying or that the paper lower density had less elastic stretch in being applied on t cable. This suggested the idea of trying the papers in r verse, i.e., the low-density papers near the conductor a the denser papers outside. This made no appreciable di ference in the 60-cycle dielectric strength, but showed greater stability of power factor on load cycle tests. T reason for this effect on power factor is, in large measure, t absence of the ionizable paper-free region mentioned. Ho ever, other factors also enter (*2*).

This proved to be of importance in the design of solid ty cables but of no value in ionization-free cables, such as t oil-filled and various forms of pressure cables. In these, was found that a few layers of very high-density pape (about 4000 Gurley) at the conductor, greatly increased t impulse dielectric strength.

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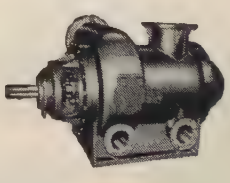
Sutherland Breaker Trap



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GRADING BY THICKNESS

Examination of polystyrene-embedded wafer-thin sections of cables showed that the tapes crossed over the underlying gaps between tape edges without dipping into them. It was therefore evident that any air or oil films therein would be of exactly the same thickness as the tapes. As the dielectric strength (volts per mil) of an air or oil film is greater the thinner the film, cable failures always start with deterioration of such films, and it was therefore obvious that the deterioration voltage of a cable could be increased by using thinner paper. As this would greatly increase costs if carried throughout a cable, it was found that the same result could be obtained by grading the paper by thickness, i.e., using the thinnest paper near the conductor, where the stress at working voltage is greatest, and increasingly thicker paper as the stress falls off with distance from the conductor. This construction is used in high-pressure gas-filled cables and in extra high-voltage cables to good advantage, the thinnest paper being usually $1^1/_2$ mils thick.

The same idea was applied by Domenach and Macardier, in France, to oil-filled cables, but they carried their experiments a step further than their predecessors by using narrow tapes of linen paper 0.7 mil thick. When such cables were taken apart, tape by tape, it was found that, unlike cables hitherto made, the tapes did not bridge the gaps between tape edges, but drooped into them, substantially filling them and thereby eliminating the oil films almost entirely. This happened because the very thin paper was made of pliable linen stock instead of the comparatively stiff wood pulp.

We would like to have an American paper which will perform this function as well as the French linen paper which we have to import.

PAPER FOR EXTRA HIGH-VOLTAGE CABLES

The dielectric loss in a high-voltage cable occurs partly in the paper and partly in the oil. That which occurs in the paper is due, principally, to the presence of electrolytes which were either originally in the pulp or were introduced by the washing water.

The power factor of insulation, which is the quality that measures the energy lost in it due to alternating electric stress, also determines the temperature rise of the paper due to electric stress alone and apart from the temperature rise to which it may be subjected by the heating of the conductor by current. The total temperature rise of the insulation is the sum of these two rises; and as the total is fixed by the limitations of the cable materials, an excessive dielectric loss implies a reduced I^2R loss in the conductor and, therefore, less current.

An insulation power factor of 0.3 or 0.35%, as ordinarily obtained with present-day impregnated paper, does not seriously lower the ampacity (i.e., the current-carrying capacity) of cables up to 138 kv. However, at 230 kv. it begins to pinch, and at 350 kv. and over it is so serious that cables for such voltages are seldom economically practicable for transmission over a distance, although entirely practicable for short runs, such as between transformers and aerial lines, where convenience rather than economy is the dominant factor. Such cables are in successful use in Sweden, where they are now operating at 425 kv.

It may be possible to attain lower dielectric losses with present paper by using some kind of synthetic oil having a power factor lower than that now attainable in mineral oil, but there is danger in this, at very high voltages, for the simple reason that stability of the synthetic oils under stress is less known than it is for mineral oil.

In my opinion, lower dielectric losses must come, in principal measure, by better paper. Low specific gravity would probably give low permittivity, so that this would suggest the desirability of paper of low specific gravity and high air resistance. Such paper, impregnated, would probably have lower power factor. The practical difficulty in improving paper is the expense of obtaining large quantities of water free of electrolytes. The available paper of lowest power factor is that made in the Springtime, when the river freshets come from melted snow. Later in the season, the river waters have accumulated from ground seepage and have picked up the baneful electrolytes from the soil. We may have to go to Switzerland or Italy for our paper, as in those countries snow water is available the year around, not far from industrial centers.

Collaboration of the American papermakers with electrochemists might be fruitful in solving this problem. Perhaps they could use economical methods of ion exchange to deionize the water.

In the meanwhile, we are planning to reactivate our laboratory paper "machine" to ascertain the ultimate possibility in low power factor, with present-day pulp, using water of controlled conductivity and electrolyte content.

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Empire State (Central District)

The May 7 meeting of the Central District, Empire State Section of TAPPI, was held at the University Club, Syracuse, N. Y., with the graduating seniors of the College of Forestry's Department of Pulp and Paper Technology as the guests of honor. The head table was introduced as follows: Durwood Geffken, vice-chairman, D. C. Mather, chairman of the Em-

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pire State Section, F. W. O'Neil, chairman, H. M. Gray, retiring chairman, R. N. Prince, secretary-treasurer of the Empire State Section, S. E. Church, secretary, and R. G. Hitchings, treasurer.

C. H. Kent, formerly resident manager of the Hercules Powder Co., Holyoke, Mass., talked on "Forty Years in Sales" or "Notes from a Sales Manager's Notebook." His remarks were directed to the graduating seniors. He emphasized the human qualities required of a successful salesman and illustrated his points with incidents from his long personal experience in selling to the paper industry.

Mr. Gray was given an enthusiastic vote of thanks for his fine leadership as chairman during the past year.

Empire State (Eastern District)

The regular April meeting of the Eastern District of Empire State Section of TAPPI was held at Milfranks on April 22, 1954.

This was the Empire State Award Contest Meeting and the following people presented papers in the contest.

Miss Chung Ying Chu, a research chemist at the International Paper Co.'s Research Laboratory at Glens Falls, presented a paper on "The Effect of Adhesives Used on the Rheological Properties of Several Coating Colors." Miss Chu's paper will be published later with others that will be presented in the Section competition.

Gordon Rabeler, a chemical engineer at the International Paper Co.'s Research Laboratory, presented a paper on "Pulp and Paper Mill Industrial Waste Surveys."

A. G. Bellos, a design engineer at The Sandy Hill Iron & Brass Works, Hudson Falls, N. Y., presented a paper on "Bleach Plant Engineering and Design."

J. Hannigan, assistant general superintendent of the International Paper Co. mill at Palmer, N. Y., presented a paper on "Supercalenders—Superheadaches."

The contest was won by Miss Chu who was awarded a $25 first prize. She also won the privilege of presenting her paper in contest with winners from other districts of Empire State Section of TAPPI at the Annual Empire State meeting at Lake Placid, N. Y. which will be held on June 10, 11, and 12.

Second prize of $20 was won by Mr. Rabeler, third prize of $15 by Mr. Bellos, and fourth prize of $10 by Mr. Hannigan.

The judges were Grant Cole of The Diamond Match Co., Plattsburg, N. Y.; Robert Blakeslee of the Imperial Paper and Color Corp., Glens Falls; and Dallam Blandy of the American Wood Board Co., Schuylerville, N. Y.

ALLEN A. LOWE, *Publicity Chairman*

Pulp and Paper Mill Industrial Waste Surveys

Gordon E. Rabeler

IN RECENT years the realization that pollution of our streams and inland waters by both industry and municipalities is a factor in general water conservation which is essential because of population and industrial expansion. Public interest in water conservation and purity has been shown by the passing of Federal Law 845 in 1948 and the New York State Law in 1949, both dealing with water pollution control. Under these laws industry will be required to meet definite standards for the discharge of their wastes. It behooves industry therefore to know accurately its manufacturing processes which can only be learned from complete industrial waste surveys.

OBJECT

It is the purpose of this paper to describe the manner and methods which can be used to conduct an industrial waste survey in a pulp and paper mill. The object of a waste survey is to determine the amounts and characteristics of effluents discharged either to a stream or to the atmosphere. The writer has performed such investigations in four mills. These mills included pulp preparation by the soda, sulphite, sulphate, groundwood, and bookstock deinking processes and varied in production from 100 to 450 tons of paper per day. Based upon his experience the following is a suggested procedure:

A waste survey as planned and carried out may be divided into three phases.

Orientation with Mill Process

The first step is to become thoroughly acquainted with the mill operations. All industrial and sanitary sewers as well as pipe lines carrying white water and process fresh water should be traced from beginning to end. Dimensions of sewers and pipe lines at various points are also taken. The above-mentioned information is then used to make four charts or drawings; the first, a line diagram showing the general process flow of the mill and the other three drawn on a plan view of the mill, indicating the industrial waste and sanitary sewers, the white water reuse, and process fresh water pipe lines.

Waste Measurement

The second phase of the survey is to actually measure the wastes. To do this, volumes and analyses of the effluents must be found. In order to check the results, sufficient data should be obtained to establish a material balance and a water balance for the mill.

Water Balance. To effect a water balance, one must measure the total volumes of fresh water entering the mill as well as the water and waste carrying effluents being discharged. Fresh water intake is through pipes under force of gravity or a centrifugal pump. Either way, these quantities may be determined by installation of a flowmeter in the lines. In conducting our surveys, a portable G.E. type F flowmeter was used. This required only a $^3/_4$ or 1-in. pipe tap to fit the pilot tube into the line. Copper tubing or high-pressure water hose was used to connect the pilot tube to the meter. The meter was of the recording type, and charts were changed daily. A minimum of 5 operating days and preferably 2 weeks' time should be spent on each individual measurement. This rule will also apply to waste measurements. If for any reason it is not practical to use a flowmeter, water usage can usually be determined from pump ratings. Two methods are available: one by the installation of recording gages on both the suction and the discharge side of the pump, and two by continuous ammeter readings on the pump motor. If the pump is in good repair and its characteristic curve is available, the average discharge in gallons per minute may be derived. If the pump is not in good repair or has been modified, for example, by a change of impeller, still another manner of flow measurement can be used. First determine the average discharge head with the aid of recording gages. At a time when the pump is operating under average conditions, determine the flow by carrying out a chemical calibration also known as the salt titration method.

The chemical calibration method may be described in the following manner: a known concentration of sodium chloride or thiosulphate solution is injected at a definite rate by means of a small gear pump into the suction side. Samples of the diluted salt are taken on the discharge side of the pump at regular time intervals. A sample blank is also taken both before and after the run. These samples are then titrated with silver nitrate or iodine solution in the presence of a suitable indicator to determine the amount of sodium chloride or thiosulphate. The product of the dilution of the salt and the rate of its addition will give the rate of flow. Details of the salt titration method may be found in TAPPI Data Sheet 6.

GORDON E. RABELER, Chemical Engineer, International Paper Co., Glens Falls, N. Y.

To complete a water balance, the effluents from the mill must also be measured. Most pulp and paper mill wastes are discharged into open channel sewers. The simplest means of accurately determining these flows is by means of a weir. A weir is a bulkhead or dam over which water flows. Discharge takes place according to the equation, $Q = CLh^{2/3}\sqrt{2gh}$, where Q equals the volume of flow per unit of time, C equals the coefficient of discharge (found by experiment for a given type of weir), L equals the length of the crest or top of the weir, g is the acceleration constant of gravity usually taken as 32.2 ft. per sec. per sec., and h is the head or height of the water above the crest. Any kind of weir or dam may be used to measure flows, but to save time involved for calibration, it is best to use a standard type.

There are many modified forms for which standard dimensions of construction and data of performance are available as in TAPPI Standard E-2. The one to be used in each case will be determined by the existing set of conditions. Should the flow vary from a low minimum, say 10 g.p.m., to a moderate maximum, such as 1000 g.p.m., a triangular notched weir might best be used since it measures low flows with greater accuracy than a straight edge or double end contracted weir. For a given channel width, a rectangular weir has approximately double the capacity. If the backwater of any of the above-mentioned weirs causes the water to overflow the channel, one then can make use of a submerged weir which operates with a lower head. A submerged weir is one in which the water level downstream is higher than the crest.

A high concentration of suspended solids in an effluent may cause an appreciable deposition of matter on the upstream side of a weir. This will change the operating characteristics and decrease the accuracy of flow measurements. A venturi or Parshall flume which is self-purging may be substituted. A flume is a device with converging side walls forcing the water to flow through a throat after which diverging side walls restore the full section. Where effluents are handled in pipes with accessible discharge ends, flumes or weir boxes can be fitted. A weir box consists of an enclosure with means for baffling any turbulence that may be present and a weir plate at the discharge end.

Head readings must be taken on the measuring devices in order to calculate the actual flow. Such measurements should be made at a distance upstream from the crest of the weir at a distance four times the maximum head. A stilling chamber is often beneficial if turbulence exists. If the rate is constant, hourly measurements are adequate. If the flow varies appreciably, a continuous record by level recorder is necessary.

Free flow from pipes of relatively small volume and constant rate can most easily be measured using a container of known volume and a stop watch.

There may be instances in which it is impossible or impractical to use a weir, flume, pail and timer, or other such flow measuring device. Consider the case of an unbleached pulp washer which discharges its entire effluent through a closed pipe which empties below the stream level. First obtain consistencies of hourly samples of pulp entering and leaving the washer. Measure the shower water used. Calculate the gallons of water per ton of pulp from the consistencies. The water entering the washer plus the shower water minus the water leaving times the number of tons of pulp being washed per day will give the volume being discharged.

Thus, it can be seen that there is no fixed rule for any one case of measurement. Careful study and thorough analysis will often present several solutions to each problem. Choice should be governed by the simplest expedient that will produce sufficiently accurate results.

A water balance may be effected with the data now at hand. The same units of measurement must be used throughout. If all significant volumes were found, the sum of the volumes of water entering the mill will be nearly equal to the sum of the volumes of water leaving the mill. The writer believes that a difference between totals of plus and minus 5% or less is obtainable.

Material Balance. At the same time that the volumes of the mill wastes are being measured, 24-hr. composite samples of the same should also be acquired and analyzed in the laboratory for the following: (1) total solids—fixed and volatile, (2) suspended solids—fixed and volatile, (3) dissolved solids, (4) pH, (5) acidity or alkalinity, (6) chlorine demand, and (7) biochemical oxygen demand.

The samples must be representative of the waste effluent. Since the value of the results of the analyses depends first of all on the quality of the samples, the sampling procedure has to be correct. Thorough mixing must be in effect at the point of sampling. Periodic grab samples may be taken in the beginning in order to discover if there is appreciable variation in the characteristics of the waste flow. On the basis of these findings a sampling procedure may be set up. If the quality of the waste varies with the rate of flow, the size of the samples taken should be varied with the rate of flow. If it is constant, a uniform size of sample may be taken. To conserve man power and also to make for greater efficiency in conducting the survey, it is suggested that automatic samplers be used wherever possible. There are many good types which are produced commercially. Those with which the writer has had some experience are the De Zurik, Trebler, and Montague. Also, it is possible to design and construct one in the mill such as that shown in TAPPI Data Sheet 46. When considering a particular type of sampler, the nature of the wastes must be taken into account. A sampler that may serve admirably well for an effluent low in suspended solids may not be suitable for one containing large particles, such as bark. Also, the materials of construction may have to withstand corrosive agents. When the rate of flow and the characteristics of the waste effluent vary considerably, a sampler that samples proportionate to the flow should be used. Needless to say, if the effluent contains no added waste from the mill processes, such as evaporator cooling water, no chemical analyses need be performed.

The writer performed all chemical analyses according to procedures given in the Ninth Edition of "Standard Methods for the Examination of Water and Sewage" which is published jointly by the American Public Health Association and the American Water Works Association.

In some pulp mills, such as ones using the "soda" and the "sulphate" process there may be considerable solids emitted to the atmosphere. These losses occur in small part at the outlet of the precipitator stock after the recovery furnace and to a greater degree at the lime stack which serves as the outlet for the flue gases from the lime kiln. The rate of flow of the gases may be determined by making pitot tube traverses across two diameters. The technique for this operation is given in "Marks' Handbook." The point of average rate of flow is calculated from these data, and at this point a known volume is filtered through a thimble filter holding device thus collecting the contained solids. The product of the weight of solids per unit volume of gas and the rate of flow gives the unit loss. It is to be understood that other measurements such as temperatures across the stack and wet bulb temperatures must also be taken in order to correct the data to conditions of standard temperature and pressure.

A material balance is made by balancing the amount of the materials entering the mill processes against the amount of salable products and the waste solids discharged to the stream or the atmosphere. The amounts of the raw materials consumed and the material produced may be obtained from mill inventory records. The amounts of the wastes have been measured in the survey. Again it is believed by the writer that a difference of $\pm 5\%$ or less between the total ingoing and outgoing materials may be obtained.

Stream Survey. A complete industrial waste survey also includes the determination of the effect that the pulp and paper mill wastes have upon the receiving waters. This involves taking samples of the receiving water after the wastes have had sufficient time for thorough mixing. One sample is taken upstream from the mill and subsequent samples are taken downstream at regular intervals to such a point that it has been determined the mill wastes no longer affect the quality of the stream. Samples are analyzed for the following: (1) dissolved oxygen, (2) per cent dissolved oxygen saturation, (3) biochemical oxygen demand (5 days at 20°C.), (4) pH, (5) acidity or alkalinity, (6) total solids—fixed and volatile, (7) suspended solids—fixed and volatile, (8) dissolved solids, (9) color, and (10) turbidity.

Temperature of the air and water at time of sampling and general appearance of river and weather are recorded. Samples may be taken at midstream and 4 ft. below the surface where practical. If the depth of the stream is less than 6 ft., it is suggested that samples be taken at mid-depth. Analyses again are performed according to "Standard Methods for the Examination of Water and Sewage."

For those who are not familiar with the significance of the oxygen analyses the following is an explanation.

Dissolved Oxygen: Oxygen from the air dissolves to a slight degree in water and in its dissolved form is used in respiration by aquatic plants. The quantity of oxygen dissolved in any body of water is determined by temperature, barometric pressure, salinity, turbulence, and aquatic life (algae).

Dissolved oxygen is also used for the decomposition of organic material both natural and introduced.

Most aquatic organisms require appreciable amounts of oxygen for existence. A few, such as certain species of Chironomus, Tubificid worms, and Corethra, are able to tolerate little or no oxygen. None of our fish, however, can exist without it.

Percentage Saturation of Dissolved Oxygen: This figure gives a value of the extent to which the process of deaeration has been carried out in a body of water. It is an indication of the amount of oxygen present in comparison with the amount that could be present under the same physical conditions in an uncontaminated state.

Biochemical Oxygen Demand: This test is a measure of the amount of oxygen consumed biochemically by the organisms present in a sample of water in 5 days and at a constant temperature of 20°C. It is a comparative measure of the concentration of the decomposable material present.

Survey Report

The third and final phase of the survey is the making of a comprehensive report. The appendix will be made up of the tabulated data, graphs, and drawings. The main body of the report should outline the object for the survey, show material, and water balances and definite conclusions if possible from the data obtained.

CONCLUSIONS

Clean water for mill process use is becoming more of a premium as the nation becomes more industrialized. Cost is proportional to the treatment required to obtain a clean usable water. Therefore, waste of treated water can no longer be tolerated. Analyses of mill effluents point out the worst offenders both with respect to waste of raw materials and to pollution of receiving waters. Under the New York State Law of 1949, the water pollution control board has been invested with the authority to classify all receiving waters in the State after surveys have been made and public hearings held. It also has the power to enforce compliance with the classifications made. Thus it would seem wise for each pulp and paper mill to know how it stands in regard to possil future classification of its particular receiving water.

Without a doubt, there are many benefits to be gained by pulp and paper mill in making periodic industrial was surveys.

Bleach Plant Engineering and Design

A. G. Bellos

THE chief qualifications for a design engineer are bas on his ability to: (1) create goods which satisfactorily pe form a given function, (2) keep the cost of the creation with economic limits, and (3) require a minimum amount of spa for installation of equipment designed.

Although all three of these considerations mentioned app to bleach plant equipment, major stress will be placed on tl first two; i.e., satisfactory performance and cost.

MATERIALS OF CONSTRUCTION

In the bleach plant, the existence of serious corrosion pro lems makes it compulsory that the design engineer giv special consideration to the utilization of adequate material

Some of the more commonly used materials are: (1) stee (2) cast iron, (3) stainless steels, (4) high alloys, (Hastello etc.), (5) bronze, (6) rubber coverings, and (7) synthetic (a) Teflon, (b) polyvinyl chlorides, (c) Ryertex, and (c Saran.

In the previous mention of utilization of materials, plea note that the adjective "adequate" was used rather tha "best." The reason for this is based on cost. For exampl cast iron will (in some applications) give a satisfactory li in a hot caustic stage. By satisfactory life, let us assume a arbitrary figure of 10 years. It is a known fact that 304 stai less will give a much longer life, so for discussion, let u say the life will be 30 years. The question resolves its then to one of whether or not a mill is willing to pay 25% more for equipment which has treble the life. In this pa ticular instance, the answer would probably be negative— partly because 10 years is a reasonable life, and partly beca is the equipment might be obsolete in 30 years.

On the other hand, in strong acid chlorine dioxide applica tions, it is not unusual for a mill to pay twice as much for Hastelloy constructed item in preference to one in 316 stai less although the expected life increase may be only 150 t 200%. In this case, however, we are comparing a life expect ancy of 6 months in 316 against a life of perhaps 15 to 1 months in Hastelloy. The reasoning behind such a choic is based on reduction of both shutdown time and maintenance In some southern mills where down time is figured at $400 an hr. it is apparent what financial saving the choice ca effect.

Incidentally, all comparisons of life and cost are purel illustrative since no given set of figures can take into accoun all operating conditions and all types of equipment involved

As a matter of possible interest, I have here samples show ing how much 50¢ will buy (in the rough form) in cast iron mild steel, 316 stainless, and Hastelloy C.

Also, here are two gaskets which are identical in size. On will cost $0.25, the other $8.00. The reason is that one i Vellumoid while the other is Teflon.

Not only does the cost of these materials vary considerably but the length of time for machining varies also. If we found that it took 1 hr. to machine a given solid round of soft cas iron, listed are the approximate hours required to machine an identical round in other materials: mild steel, 1.3; cas iron (hard), 1.6; stainless, 3.0 to 4.0, and Hastelloy, 8.0 to 10.0.

A. G. BELLOS, Design Engineer, Sandy Hill Iron & Brass Works, Hudson Falls, N. Y.

Unfortunately, it seems that the machining time increases almost in direct proportion to an increase in material price.

METHODS OF CONSTRUCTION

Casting

Generally speaking, casting is employed for items which are repetitive, or which have complex contours. However, this is not a hard and fast rule since each problem has to be judged on an individual basis.

The biggest problem in designing for castings is to minimize unequal wall sections since these will have different temperatures in cooling. Unequal temperatures cause cracks which are visible to the naked eye, or they cause the setting up of invisible stresses which ultimately cause field failure. The use of generous fillets and radii is a must in order to minimize stress concentration and to give added strength to the casting.

Welding

Each year finds that more and more bleach plant equipment is being made of welded stainless steel construction. Some of these items include vacuum washers, single and double shaft mixers, dilution nozzles, tower scrapers, agitators, pumps, and rotary feeders (star valves).

For this reason, we will confine our discussion on welding to stainless steel only.

The most serious problem from the standpoint of designing a weldment to be used in corrosive conditions is carbide precipitation. This is a phenomenon which occurs in a temperature range of 800 to 1500°F. with maximum effect at about 1200°F. In these temperature ranges, carbon comes out of alloy solution and unites with the chromium to form harmful chrome carbides. These carbides (which have relatively small corrosion resistance) precipitate along the grain boundaries and make the weldment extremely susceptible to so-called "intergranular corrosion."

Methods of Controlling Carbide Precipitation

Full Annealing. Fortunately, at elevated temperatures (around 1900°F.) the chrome carbides become dissolved and re-enter the alloy solution as chromium and carbon. If the weldment is then cooled below the lowest critical range temperature of 800°F. in 3 min. or less, the carbon does not have enough time to precipitate and remains in alloy solution. The annealing cycle for stainless is as follows: heat to 1850 to 1950° and hold for 1 hr. per inch of thickness (minimum, 15 min.). Cool below 800° with 3 min. The cooling may be an air or liquid quench.

Use of ELC Stainless. Carbide precipitation is in part a function of the amount of carbon available to unite with the chromium. ELC 304 stainless has a carbon content of about 0.035% maximum as compared to 0.08% in ordinary 304 stainless. For this reason, the ELC stainlesses are invaluable in reducing the amount of carbide precipitation.

Use of Stabilized Stainless. The so-called "stabilized" stainless steels, 321 and 347, owe their success to titanium and columbium, respectively. These metals have a greater affinity for carbon than does chromium, so the carbon unites with them instead. In the stabilized grades, the amount of titanium or columbium is always indicated as a multiple of the carbon content to insure that the available carbon will unite with them rather than with the chromium.

Controlled Welding. Due to the size of some weldments, it is not always possible to anneal them. In such weldments which are subject to severe corrosion, our engineering drawings actually specify a water quench. This is to insure that the welded area will cool below 800°F. within 3 min. The quench can be effected by use of a water spray or by sloshing water on the area with a rag.

Machining from Stock Shapes—Rounds, Bars, etc.

Little need be said regarding this method except to acknowledge its existence.

SHAFTS

The design of shafts and journals for vacuum washers, pumps, circulators, etc., is simple from the strength viewpoint since the loads are either known or can be safely estimated. Stress concentrations can be minimized by using adequate shoulder fillets to eliminate sharp corners.

However, no one can accurately predict the rate of wear on the shaft in the area through the packing. Such wear is a function of the type of packing, and how much and how often the maintenance man tightens the gland. For these reasons it is standard practice to provide protection for the shaft in the form of removable sleeve.

Although such a design is economically sound from the standpoint of manufacture—and especially maintenance since it provides for replacement of a sleeve instead of a shaft—it does not fully satisfy the requirement of "satisfactory performance" in all cases. This applies to unusually abrasive conditions of pulp or sealing water. In such instances, a hard facing of Stellite, Colmonoy, or similar material is fused to the sleeve in the wear area, with the result that the life is increased by 100 to 200%.

Where stainless steel sleeves are used, care should be taken to insure that the packing is not graphite lubricated. Graphite is quite distant from stainless in the electromotive series. Consequently, the presence of water causes a strong electrolytic action which actually pits the stainless. Powdered mica is an acceptable lubricant.

While a sleeve on the shaft answers the wear problem, additional provision must be made to protect the shaft from corrosion caused by seepage past the end of the sleeve. We have found that a polyvinyl chloride "O" ring mounted on the shaft, and compressed by the sleeve into a counterbore, provides excellent protection against end leakage and subsequent shaft corrosion.

NECESSITY—THE MOTHER OF INVENTION

Some years ago there was an antifriction bearing failure on an agitator for a stock chest. This in itself is not startling, but the combination of circumstances pyramided to cause a real mess. First of all, the chest was round, unusually large, and was completely covered except for two small inspection hatches. In addition, the stock was of a relatively high consistency. By the time the bearing failure was noticed, the transport pump was completely clogged since the cessation of circulation permitted considerable dewatering to take place.

Inspection of the agitator revealed that it would have to be completely removed in order to effect bearing replacement. This, of course, was rather "difficult," since the chest was full, and the stock could not be pumped out because of the clogged transport pump. The use of fire hoses served only to prove that the method was futile. It was then decided to temporarily by-pass this particular chest, and in view of the value of the pulp involved, to empty the chest by buckets. This, needless to say, took a couple of days of hard work. Eventually the agitator was removed and the bearings were finally replaced.

The situation just related is one of those "one in a thousand" conditions, but when it happened, it made the design engineer involved feel normal for such circumstances—namely, 2¢ worth. In typical fashion, the engineer pitied himself and cursed the checker over and over. Eventually he did sit down at his drawing board and worked out a solution. The result is, all of our antifriction bearings (which are used exclusively) on bleach plant agitators and pumps can be replaced without removing either the shaft, the agitator, or the impeller. No longer do we lose sleep at night

over the possibility of the "one in a thousand" chance happening to a 17-ft. diameter by 102-ft. high bleach tower.

The reason this story has been told is to point out that the trouble caused one mill made it necessary to make changes which improved the products made available to future users.

ENGINEERING PRINCIPLES

All design engineers pride themselves on their ability to make correct snap judgments based on their knowledge of engineering principles.

Some years back a mill producing rayon pulp decided to install a new horizontal storage chest. As in most mills, the only space available indicated that a row of building columns would have to wind up in the middle of one of the partitions. The engineer was consulted as to whether the chest would work—and out came the snap decision. Based on a very vague acquaintance with aerodynamics, the engineer said he thought the operation would be satisfactory, *if* the columns were built up with concrete in the shape of airfoils. The theory behind this reasoning, of course, was to minimize resistance to the stock flow. The suggestion was considered, incorporated, and the chest was eventually put into operation.

For several months the chest seemed to work acceptably, but shortly afterward things began to happen. The flow began to rapidly resemble the flow of molasses on a below zero day—namely, nothing moved. It was then decided to shut down, clean up, and check the chest.

When the inspection crew entered the chest two things struck them. The first was the huge mats of stock collected behind each "scientifically engineered airfoil" column. The second thing was the almost unbearable stench of this rotted pulp.

The stock was shoveled out and dumped in back of the mill, but for some reason, a curious research chemist decided to make tests. Believe it or not, this pulp made the finest rayon ever made in the lab. The product was so good, that the mill actually tried to rot pulp intentionally in order to duplicate the original material. The experiment never did prove successful.

If this story has to have a moral, it would have to be—"beware of snap judgments—they have a habit of snapping back."

In the design of any equipment a knowledge and correct use of engineering principles is imperative.

As an illustration of some of the problems that arise and how they are solved, let us consider a small but extremely important piece of equipment. This item is the sealing valve on a vacuum washer. Although all sealing valves have the similar function of controlling what washer cells are under vacuum, and also where and how the vacuum break is effected, my remarks will apply only to the valve used on a Kamyr vacuum washer.

On the Kamyr vacuum washer the valve is a stationary member, and consequently was supported independent of the rotating shaft which was carried in plain bearings. As the plain bearing wore, no longer did the independently mounted valve have a common center with the valve ring face. Therefore, there could not be a theoretically true sealing surface without either replacing the bearings or adjusting the valve. One of the possible answers to this problem was, of course, obvious—do away with the wearing element (in this case the plain bearings). Antifriction bearings were substituted and are now standard construction.

The vacuum break is necessary in order to permit removal of the pulp mat from the washer drum. This is accomplished by introducing atmospheric air pressure into a cell which is under vacuum. While the washer is handling its rated capacity there is no problem. But as you well know, normal operating practice is to crowd the washer to the extreme. This crowding eventually means that the cells are not completely emptied before coming into the vacuum break area. This is where the trouble begins since a sudden transition from vacuum to air pressure in a cell will actually blow the water remaining in the cell out through the pulp mat. This magnifies the wet streak sometimes seen just ahead of the pick-up roll. It is undesirable since it means that the pulp mat consistency is not constantly uniform.

Here again, the answer to the problem was not difficult. All that was required was a gradual entry of air instead of a sudden surge. On the Kamyr washer, this was accomplished with a V slot cut into the valve. The first contact the circular cell outlets make with the valve is with the bottom of the V, so only a small trickle of air can enter. As the drum revolves, the opening gradually opens to the full width of the V—thus effecting a gradual vacuum release.

The Kamyr sealing valve is designed as a segment of a cylinder so it resembles an internal brake shoe. It is a pivoted valve, so is self-aligning. The seal is positive since it does not rely on water. The valve also has an unusual characteristic in that it is mounted in the vacuum chamber, but the inside of the valve proper is under atmospheric pressure. A differential pressure always exists, and this pressure tends to push the valve away from the surface to be sealed. This apparent disadvantage, however, became the basis for the patent on the Kamyr valve. By making use of a combination of fundamental engineering principles the valve became a constant pressure valve—no matter what the vacuum.

EXPERIMENTATION

Occasionally an engineer comes up with an idea which seems to be sound theoretically, and yet there is skepticism as to its operational value. In *some* cases, a model built to small scale can be extremely helpful in experimentation—and also as a converter of skeptics.

The model was constructed to check a theory regarding an idea for a blending tank. A short time after the model was built, we had an inquiry for a blending tank along other lines, but this model helped to make the sale of the new design. With the experience gained from the model a 10-ft. diameter by 12-ft. high blending tank was built. It is now in operation—blending pulp, three chemicals, and steam—and seems to be doing a satisfactory job.

NEW DEVELOPMENTS

In engineering there is a saying that, "If you're not going ahead, you're falling behind." In other words, there is no such thing as standing still.

At present we have two brand new developments on the drawing board. Unfortunately, I am not at liberty to go into any detail. I can say that the ideas are revolutionary with respect to handling and treating high-density pulp.

SUMMARY

The various subjects discussed only scratch the surface with respect to bleach plant design and engineering. Despite some examples to the contrary, engineering actually is an exact science. The occasional floundering we do is normally due to ignorance of operating conditions in four mills. With your assistance this problem can be greatly minimized.

Supercalenders—Superheadaches

J. Hannigan

THE purpose of this paper is to give you an insight into some of the problems connected with supercalendering, with emphasis on machine-coated papers. Due to the great variety and diversity of these problems the detail in which I can dis-

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cuss and describe problems individually is necessarily limited. Supercalendering machine-coated paper has uncovered headaches—severe beyond imagination. The key role played by supercalenders in the over-all process of making this grade of paper is best briefly described by a few lines of exquisite poetry:

> The super's the thing for the high finished sheet
> By means of loading the steam and the heat.
> When the paper is right and the super in order
> The buyer and printer both hasten to order.
> But if stacks put in defects or finish is bad
> Complaints roll in and management's been had.

Although the name itself, "machine coated," implies that the making of the sheet and the application of the coating surface is done in one operation, no hint is obtainable from the name concerning what happens to this paper after it comes off the machine winder. In order to supply magazine publishers with the smooth, level finish necessary for the heat-set inks of today, the paper must be supercalendered.

Now, of course, the supercalendering operation as such is not a new one. Rotogravure papers, particularly for catalogs and magazines, have been supercalendered for many years. However, I think you will agree with me at the termination of this paper that the application of that thin film of coating to the surface of the sheet has added to the problems of the supercalender-man one thousand fold.

At first thought it might be expected that some of the old machine defects with which we are all familiar might be covered up or hidden by this layer of coating on the surface, thereby facilitating the supercalendering operation. Nothing could be further from the truth. Slime holes, lumps, cockles, and drier wrinkles are still evident as slime holes, lumps, cockles, and drier wrinkles. Other defects are still as evident and annoying as ever, even to the most minute detail.

To this endless mass of defects which has greyed papermakers for years, are added defects put in by the coater, another set of driers, and a second small machine stack. Additions such as coater wrinkles, pull marks, speckle, stickers, bar marks, scabs, and printing make the coater at times render the impression of an ominous monster. Afterdrier wrinkles and drier scale are the major novelties introduced by the afterdriers.

Old-fashioned defects plus the added elements graciously supplied by the coating process itself, although theoretically torn off at the machine winder, all too often find their way to the supercalenders.

Our supercalenders are equipped with cotton-filled rolls with the conventional double finish or cotton-to-cotton nip. Cotton rolls, although adapted to the high finish required of coated papers, tend to mark more easily than the blue denim paper-filled rolls as used on uncoated papers. As a result of defects, as described previously, which may possibly show up anywhere in any roll, the supercalender operator must be constantly vigilant and attentive to business in order to prevent smash-ups. Even with utmost attention and with emergency stop buttons located at different points around the stack, occasional smash-ups result.

These smash-ups at times are unbelievable in severity. Of course all breaks in the calender do not cause severe smash-ups. Occasionally a break occurs and no damage results.

However, usually when a break occurs anywhere in the stack the sheet is held out of the succeeding nip for an instant by a doctor on one of the iron rolls, and then is pulled through in a wad. This, of course, marks the cotton roll severely.

At times these marks, if not too deep, can be removed with tools and sandpaper without removing the roll from the stack. All too often, however, the roll must be immediately removed and replaced by another roll. The damaged roll must then be turned down in a lathe and refaced. This problem is basically no different then has existed for years on supercalenders running paper-filled rolls. However, it is more frequent and severe where cotton rolls are involved because of their inherent softness. Shutting a stack down to change rolls has alarming ramifications. It can be done in our mill in from 2 to 10 hr. depending upon how many rolls must be changed and in which stack. Of course during this period the paper machine is still turning out rolls every half hour or so. This means that a large number of rolls collect on the floor in front of the stack. Not only does this situation tend to crowd an already limited floor space but there is always the possibility that much or all of this paper contains defects that will prove disastrous when the stack finally starts up. Things of this nature are usually caught before too much paper is made if the stack is caught up with the machine.

Fortunately, breaks in coated paper supercalenders tend to be somewhat reduced by the use of spreader rolls rather than spreader bars. Spreader bars, due to their tendency to scratch the soft coated surface had to be replaced by small, properly crowned spreader rolls. It is felt that defects that tend to catch on a spreader bar run over the spreader rolls. This characteristic requires great attention on the part of the operator to insure that defects are not shipped to customers.

Our experience with spreader rolls has been a long and arduous one. Because our rolls were originally crowned wrong, that is, they were the wrong shape, we were unable to run rolls in the top nip on both front and back of the stack. This top nip is the point where the sheet is first crushed and is stretched in the cross direction to the greatest degree. As a result it is here that spreader roll crown is the most critical. Any degree of wrinkling on these spreader rolls means immediate calender cuts. Calender cuts are still calender cuts on coated papers. As is the case with other defects, the coating does absolutely nothing to cover or hide these nightmares.

Let us now assume we have the properly crowned spreader rolls, properly adjusted fly rolls, and we are running a sheet which we are sure is 100% free of mechanical defects. (This latter assumption, of course, is strictly a hypothetical case.) Our next worry must concern the surface or finish of the sheet as it comes off the stack. There are only two ways to increase finish on coated paper (assuming coating and formation are up to standard). The first is by increasing the loading on the stack. However, here we suddenly run into a limitation that must preclude any prolonged excessive nip pressures. This limitation is, of course, the wear and life of the cotton rolls. Most of the cotton filling used in these rolls will burn at 180 to 200°. The more the stack is loaded the hotter the rolls tend to run. The climax of this increasing heat is the blowing out of the cotton filling of one or more rolls. Usually the rolls will start to darken in the hot spot before actually bursting. The burning is caused by friction from the cotton fibers rubbing together. This action almost always starts near the core and works outward to the surface. By the time a small spot appears on the surface of the roll a large area underneath that spot is usually completely burned. If the burst is of this type the roll can only be removed from the stack and returned to the roll manufacturer for refilling.

Since refilling a roll from one of our big stacks costs in the neighborhood of $2000 we somehow feel that excessive loading is not the answer to our finish problem, although proper loading is a must. Since loading alone is not the entire answer let us take a look at our second way or means of helping the stack give the sheet the finish currently being demanded by printers. This is by means of moisture. Now we can get moisture from the machine, that is, in the sheet itself or from moist steam applied to the sheet at the stack from steam showers.

Again we must have a little or both. If we have too little of either we cannot hope to obtain the required finish. If we have too much of either the results can be absolutely catastrophic, as we shall presently see. We, as everyone else making this grade of paper, use starch as the adhesive in the coating. The starch adheres the clay particles to the sheet and to each other. However, starch is soluble in water.

This means that water will instantly turn the firm coated surface into a gooey mess.

If the sheet is too wet going into the coater more coating penetrates the sheet and we suddenly find our afterdriers full of a fine hard scale. This excessive coating penetration is greatly aggravated by the fact that as we go up in moisture, the moisture variation across the sheet increases. Hence we also lose uniformity of penetration. This not only distorts our surface but as we shall see, throws a real curve at the supercalender.

As mentioned earlier all our supercalenders are equipped with steam showers. These showers are located directly under the fly rolls, as close to the stack itself as is practical. The volume of steam from the showers is increased or decreased by the operator as a supplement to the moisture in the paper. Since it is impossible to tell from looking at the sheet the exact moisture content therein, the operator must guess how much steam to use on a given roll. He has no way of being sure whether the sheet is high enough in finish until the roll has been run and he can look closely at the sheet. If it is too low it is then too late to be remedied especially if the log is cut into rolls on a supercalender winder as is the case at our mill. He can only increase his steam on the next roll which may turn out to be excessively damp.

It is here that we run into trouble. When the paper is too damp, either from the machine or from the supercalender showers a fine dust is picked off the sheet by the stack rolls, usually on the iron rolls and usually at the top of the stack. This dust gradually thickens to a point where it becomes flakes or scale. In extreme cases we have seen a cloud of this scale literally pour out of the stack. The rolls will tend to scale up in a small area—a damp streak in the paper. We have seen filled rolls smashed up by this scale to a more severe degree than even the bad paper breaks described earlier. This dust turns to scale often before the operator can shut the stack down.

Conditions such as described above are extreme. As additional tools to insure that paper of uniform moisture content comes to the supercalenders we have installed moisture measuring devices on both coating machines. These instruments give the backtender a continuous graphic picture of moisture in his paper, and have proved invaluable. The guesswork and individual opinion have been removed from the picture. The paper has the proper moisture content or it does not. The old arguments between supercalender and machine crews as to whether the sheet should be dampened up or dried up are a not too joyful memory. More important, the violent swings in degree of finish have been greatly reduced.

However, the scale problem did not vanish with the introduction of these electronic backtenders. In accordance with the theory of supercalendering we feel that we get our finish on the top side of the sheet at the top of the stack and the finish on the wire side of the sheet in the bottom half of the stack. This is because our top side is against the iron rolls above the double finish nip and the wire side is against the iron rolls below the double finish nip. The actual finish comes from the iron roll, not the filled roll as one might at first think. What actually happens in one of the nips of a supercalender is probably most clearly understood if we first think of the ironing board, the shirt, and the iron. The iron roll is the iron, the paper is the shirt, and the cotton roll is the ironing board. The iron roll sinking into the cotton creates a squashing, ironing action and the high spots on the surface of the sheet are knocked down and spread out so that they more nearly conform to the low spots. The result of this action is the finish or surface levelness that is so necessary in modern half-tone or four-color printing.

Since we get our finish on the top side of the sheet at the top of the stack this is where we have our steam showers. The big roll of paper on the unwind stand, the sheet coming from the top of this roll and passing over the top roll of the stack, plus the stack itself form a sort of box or enclosure. It is in this box that we are introducing the steam to the sheet. A may well be imagined the humidity in this semienclosure terrific. The sheet is not only dampened by the steam itse but also by this extremely humid air. This humid air tend to aggravate the scale condition. To overcome this diff culty we employ small electric blowers mounted on one en of the stack, which, by means of an air stream push this supe humid air out of the enclosure at the other end of the stack However, even with the blowers we find that in order to b safe we must run doctors on the top steel roll. In fact, ac tually we run doctors on all steel rolls, although many othe mills operate with doctors on only the top and bottom rolls.

In addition to the blowers we also use a small air jet blow ing parallel to the nip below the top fly roll. We use a steam shower under this fly roll and the steam has a tendency t follow the sheet into the nip. This condition actually ca saturate the sheet with moisture causing scale, breaks, c just unsalable paper. Even with all our blowers, air jet doctors, etc., if the sheet is too wet coming to the supercalen ders we can still scale, even severely.

Now that we have cracked the shell of sympathy with few major headaches, let us now look at a real migraine Early in the game, which really was only a few short year ago, when we were just getting into a few of the problems a previously mentioned, we suddenly had a rush of complaint from printers all over the country about glue in our roll Printers running our rolls would suddenly find two wraps o the sheet inseparably stuck together. The result of this wa at least a web break and possibly printing plate batters.

After much hair pulling we found these sheets were not held together by glue as such, but by a mixture of water and th starch in our coating formulation which is nothing mor than the paste Mother used to make for us on rainy days. single drop of water striking the sheet prior to its being woun up in the roll acts as thoroughly as any glue. Where coul water come from in a dry supercalender room? The mos important source is condensation or sweating on the stac frame, ends of fly rolls, spring rolls, parts of the hood, etc. O course if the room temperature is maintained high enough sweating can be eliminated. However, the placement o doors through which we must constantly bring rolls in an out precludes in our case absolute temperature control an maintenance. Therefore we are forced to wrap all area with even a tendency to sweat with used machine wet felt This gives the stacks a sort of mummified appearance but very effective in stopping waterdrops from this source. Al though effective these felts are a real problem to keep clean and are the cause of much lost time because of the time re quired to "felt up" after roll changes, etc.

Other major sources of water drops are such seemingly fan tastic things as improperly functioning steam showers, per spiration from operating personnel, and leaking or sweatin of the roof of the building. Today although everyone in th mill is acutely aware and watchful for any possible source o water, we still get the occasional flurry of "glue in roll" from some pressroom. In short, this still is one of our major ulce stimulants. However, as critical as these waterdrops are we must rank them a poor second in the race for the defec championship. The champion, the parasite that has haunte —as far as I know—every company making this grade o paper, is the winder burst. The term itself is not a new one For years, cracks across the sheet, caused by an excessively hard edge, have been known as winder bursts. However, th burst as we have come to know and dread it is to us, at least a new brand. Although occasionally in the cross direction 99.9% of these bursts run in the machine direction. Som are as long as 40 to 50 ft., some are as short as 3 in. Thes bursts are splits in the sheet that have the appearance of rent or lengthwise pull apart. The only way we can be sur that a roll contains or does not contain bursts is to rewind it for the bursting takes place after the sheet is wound up in th roll. Exactly where no one is sure.

Sometimes a roll, on being removed, is found to have only one small burst, possibly 3 or 4 in. from the top. Other rolls are literally loaded—sometimes with as many as three bursts running parallel to each other from the top to within 6 in. of the core. We have periods when we get bursts in every roll and then we have periods when we get what we call spasmodic or intermittent bursts. That is—not every roll which we rewind as a check contains bursts but there is the occasional one—enough to keep us constantly in a quandary. Quite often one end or the other of the burst runs into what we call a jump wrinkle—a hard creping of the paper in a streaky, rambling pattern. We have never been able to feel sure whether the jump wrinkle causes the bursts or the bursts cause the jump wrinkles.

This general uncertainty or vagueness is characteristic of the entire problem. There have been times when we could stop the bursts by scouring or sanding rolls in the supercalender. Other times this is done with no results. Sometimes leveling the sheet on the wire helps. Sometimes no. Sometimes when our pulp strengths drop to the low side, bursts break out on both machines and all stacks. Often the strength drops with no resulting bursts. There have been times when we have felt that slightly out of round cores increased the bursting tendency. Mechanical condition of winders has been felt to have a bearing on the problem.

As you can see from the thumbnail sketch I have given, although our experience with bursts is great our conclusions are indefinite. There have been enough constants in the picture to draw a few semiconclusions which are actually more "guess" than conclusion. For example, it seems that the bursting tendency is increased with big diameter rolls. We seem to get more bursts in 40-in. diameter rolls than in 34-in. diameter rolls. Bursts also seem to be aggravated by high finish. That is, the damper we run the sheet the closer we seem to flirt with the burst problem. Although as yet we have been unable to find any concrete evidence that would indicate the part that stock may or may not play in the bursting tendency we suspect that stock may be behind the entire problem. There have been times when the stock was right, we have tried to make the sheet burst. We have deliberately upset the sheet on the wire, run the supercalenders in as distorted a way as possible, all to no avail. However, it seems that if the stock gets to a point, what point I certainly do not know, a slight loss of balance on the machine, stack, winder, or all three can push us off the cliff into a burst chasm.

The results of bursts are several. No matter how careful we are, the occasional bursts still get out of the mill and into the pressroom. You can well imagine the press breaks that could result from a roll full of these babies. Our concern over the problem at times verges on panic. Rewinders, during bursting periods, are completely overtaxed and are used to "check for bursts" rather than normal rewinder functions. The upshot of this is that during a major siege a large backlog builds up in front of the rewinders, an obviously unhealthy situation. Since rolls containing many bursts are good for nothing better than the broke beaters, our losses to the broke system increase tremendously. All in all it is not hard to see that bursts and all that go with them are a mighty tough proposition in the pocketbook, not to mention wear and tear on operating personnel.

Let us now briefly review some of these little problems confronting supercalender personnel. If the paper coming to the supercalender arrives with proper moisture content, uniform coating application, is free of mechanical defects from the machine wet end, driers, coater, or afterdriers, the stack operator has a relative cinch. He merely has to watch for marks in his filled rolls, overheating filled rolls, scale, waterdrops, bursts, blow cuts, calender cuts, doctor marks, etc. In addition to the above we also make shipping rolls on a winder on the stack. This, of course, adds problems in roll building, slitter setting and care, splice making, shaving handling, etc. Supercalendering is only one operation in the long line from woodpile to finishing room. As long as things run properly both in the mill and the pressroom we may tend to overlook the major part it plays, particularly in the manufacture of machine-coated paper. However, let a blast come in from a pressroom about low finish, poor winding, stack marks, waterdrops, bursts, or host of other gremlins—the first place we look is the supercalender. It is evident that these problem are major today. It is a good bet that as time goes on and we gain experience and know-how we will overcome most or even all of the problems discussed above. However, it is also a good bet that an entirely new set will rear its ugly head to take their place.

Delaware Valley

Chairman Frank Lovegren opened the April 23 meeting of the Delaware Valley Section at which 75 members and guests were present at the Engineers Club, Philadelphia, Pa. The chairman announced the results of the election of officers:

Chairman—Emil Padavic, Container Corp. of America
1st Vice-Chairman—E. C. Molin, Glassine Paper Co.
2nd Vice-Chairman—P. E. Nethercut, Scott Paper Co.
Treasurer—C. R. Calkins, Riegel Paper Corp.
Secretary—Carl F. Ackerman, Union Mills Paper Co.
Section Executive Committee—H. C. Brill, du Pont, and F. J. Lovegren, P. H. Glatfelter.

He introduced C. J. Sibler (West Virginia Pulp and Paper Co.), general chairman, Engineering Div., TAPPI, who spoke briefly on the Engineering Conference to be held next Fall in Philadelphia.

Harold Brill reported the progress of the negotiations of the Library Committee with the Franklin Institute (for the purpose of buying books on paper technology for the latter institution).

A. L. M. Bixler (Riegel Paper Corp.) reminded the audience of the Thwing-Albert Award papers at the next meeting, and then introduced the speaker, R. Hunt Brown, Ernst and Ernst, New York, N. Y., who spoke on "Automation in the Pulp and Paper Industry."

Mr. Brown described the process of automation, which devotes automatic operation and the process of making things automatic. It may be considered as the Second Industrial Revolution. Present-day automatic equipment has reached a point where it can take over numerous routine office and factory jobs. Providing all the necessary facts and relationships are in the input to the machines, they can solve extremely complex problems. Eventually industry will shift from recording instruments and manual control (as in oil refineries today) to direct measurement and control of complex processes. Following Mr. Brown's general survey, interlaced with numerous examples, the floor was open to questions and for almost an hour numerous questions regarding the role of automation in the pulp and paper industry were asked. It was evident that many phases of papermaking must be reduced from an art to a science, before the correct inputs could be "fed" to a controlling device, but that given the basic knowledge and facts such devices would be feasible.

C. R. Calkins, *Secretary*

Ohio

Starch was the topic of the April meeting of the Ohio Section of TAPPI which was held in Indianapolis, Ind., on April 8, 1954. The meeting consisted of three phases: (1) a tour of the Indianapolis plant of National Starch Products, Inc., in the early afternoon, (2) a symposium and panel discussion on starch held at the Lincoln Hotel in the late afternoon, and (3) a dinner meeting at the Lincoln Hotel. The panel moderator was Herbert A. Smith of The Mead Corp.

and panel members were J. Thomas Schoch of Corn Products Sales Co. who spoke on starch chemistry, James P. Casey of A. E. Staley Manufacturing Co. who spoke on "Starch for Wet End Addition," and J. E. Killinger of Penick and Ford, Ltd., Inc. who spoke on "Surface Sizing of Paper and Board." The address at the evening dinner meeting was given by A. T. White of National Starch Products, Inc., entitled "Tailor Made Starches for the Paper Industry."

Starch for Wet End Addition

James P. Casey

STARCH for wet end addition is a very old subject dating back to the early days of papermaking. Up to fairly recent times, it was the principal way of adding starch to paper. It wasn't very long ago that all paper coating was done with casein, a size press was unknown, and what surface sizing was done in the tub was done largely with animal glue. However, during all that period and for many years before, starch was a very important part of the beater furnish and beater sizing with starch was considered to be a very important operation. Today we refer to this more properly as wet end addition, because the starch is frequently added at places other than the beater and, in fact, some mills have no beaters at all.

When paper mills started to use starch in their size tubs, and later when they began to install starch presses specifically for adding starch to the surface of their paper, it began to look as though the wet end addition of starch might become a thing of the past. It was widely believed then that just as soon as a mill could afford to install a size press that it would take out of the beater what starch was being used there and add it to the surface of the paper. The advantages of surface application were considered to far outweigh the benefits to be derived by beater addition. These were considered to be: (1) 100% retention of starch versus a figure for beater application in those days of about 40 to 60%. (2) More efficient use of the starch since it would be applied mostly on the surface where it was most needed, since, after all, most paper requirements in the grades where starch is used are surface requirements.

There is no question but what surface application of starch was a big advance and that many papers made today would be very difficult, if not impossible, to make without it. However, it has definitely not replaced wet end addition. Those mills that have tried to do this found that their papers lacked certain qualities, and most of them have gone back to wet end addition of starch. In fact, it seems that there is as much, if not more, interest in starch for wet end addition today than there has been at any time in the past.

Building internal strength into paper can be done in many cases much more effectively with starch used *in* the furnish than with starch applied *to* the surface. For example, in printing papers it is possible to obtain a very high wax test by applying starch only to the surface of the paper. However, this paper may not resist bodystock splitting during printing as well as a paper having a lower wax test, but having more internal bonding strength achieved by the addition of beater or wet end starch.

How did starch happen to get started in the wet end? One of the reasons given years ago was that the beaters were the simplest place to add it. This is certainly not true today. Cooking in small batches with all the manhandling required in adding cooked starch at the beater is one of the most awkward, unpleasant, and expensive jobs in the beater room. In spite of this, mills have persisted in using beater starch which is a testimonial to the value they believe they gain from it. However, most mills are turning to improved methods of cooking and handling to facilitate the job and improve the results.

What takes place when starch is added at the wet end is

JAMES P. CASEY, A. E. Staley Mfg. Co., Decatur, Ill.

Starch Panel (l. to r.): T. J. Schoch, Corn Products Mfg. Co.; J. P. Casey, A. E. Staley Mfg. Co.; J. E. Killinger, Penick & Ford Ltd.; and H. A. Smith, Mead Corp., moderator of the panel

close to being the least understood of any operation in the paper mill. This is not surprising when you stop to realize how complex the wet end pulp-water system really is. When to this is added an equally complex starch-water system, the result almost defies understanding.

A starch system may contain any of the following: (1) uncooked starch granules which are comparatively small and pretty much inert, nonadhesive in character; (2) swollen granules which are quite large and very sticky in character; and (3) finely dispersed starch which might be anything from a fine suspension, to a colloidal dispersion, to a state of true solution.

The fiber-water system may contain whole fibers, broken fibers, and fiber debris. The fibers themselves may be of different types coming from different wood sources, and may be pulped by different processes to varying degrees of purity. Even if they all come from the same source, there still may be a wide variation in their size and in their degree of purity. The fibers may present a surface which varied from one which is relatively smooth to one that is microscopically fuzzy in nature. Coupled with this may be a varying degree of surface water attraction or hydration. Then to complicate the system still further, the furnish may contain aluminum complex, finely divided pigment, dyestuffs, rosin or wax size, resins, and other substances—all competing for a place on the fibers and any one of which is capable of changing the fiber-water-starch relationship.

The competition which exists among the various materials in the paper furnish may be shown by experiment. For example, it can be shown that starch and rosin sizing will strongly compete for the alum added to the furnish, and that unless considerable alum is present to satisfy the demands for both the starch and rosin sizing that neither one will produce its maximum benefit. The addition of oxidized starch to a furnish containing a fixed amount of rosin size and alum will, after a certain amount of starch has been added, gradually lower the sizing value of the paper until it practically disappears. However, if supplemental alum is added with the starch so that the alum demands of both products are satisfied, the sizing value of the paper will be markedly increased. In addition to this competition for alum, starch may have a competitive attraction for the other ingredients of the furnish. Nearly every papermaker, for example, is familiar with the competitive effects of starch upon certain dyestuffs.

I am emphasizing the complexity of wet end addition, and I think it is obvious to everyone that we know relatively little about the basic or fundamental things which govern this system. However, there are certain things that we are reasonably sure of and I would like to list those. Perhaps I better put it that these are the things that I *think* we know.

1. If starch is added uncooked at the wet end and not subsequently cooked during drying, it merely acts as a filler and produces no beneficial effects. It will actually lower the strength of the paper.
2. If thoroughly cooked starch is added to a simple fiber-

water system with no other agents present, the starch has only a slight beneficial effect.

3. The retention of starch and its beneficial effects are greatly increased by the addition of alum to the furnish. The alum presumably changes the electrostatic charge on the fiber and starch so that there is an attraction between them.

4. The beneficial effects of alum on the retention of starch are generally still further improved by the addition of supplemental alkali to the furnish. This apparently increases the amount of aluminum complex which acts as a fixing agent between the starch and fiber.

5. High viscosity starches appear to be more effective than lower viscosity starches when added in relatively small quantities.

6. Starch which exists in the form of large swollen granules appears to give the best results in coarse, bulky papers, whereas finely dispersed starch may do better in the higher grade, more dense papers.

7. Oxidized starches have a special effect in that they apparently act as a protective colloid and improve the sizing obtained with rosin size. They also have a favorable effect on formation.

8. The results obtained with starch are better if the starch is added after all the refining of the stock is done. This generally results in improved retention and better strength, and it may result in more slowing up of the stock.

This about exhausts the things which I know about wet end addition of starch. There has been entirely too little study given to this application, and, in fact, we have only scratched the surface. It is gratifying to me that the Corn Industries Research Foundation is at the present time considering establishing a project to study this important application of starch in paper. There is no question in my mind but what further study will uncover some useful and beneficial facts on this subject.

Surface Sizing of Paper and Board

J. E. Killinger

I AM indeed honored to serve on your panel today, and, in keeping with advice from our moderator, Mr. Smith, I understand I will have about 20 minutes to discuss surface sizing with starch, with starch and other film-forming materials, and with starch and pigments. This is quite an assignment to cover in the time allotted. For discussion of this most embracing subject, I shall separate it into several parts including surface sizings and coatings at the wet end, at the breaker stack, at the size press, and, finally at the calenders.

First, before discussing sizing applications at the various locations on the paper machine, let's take a very brief look at the reasons that surface sizing is necessary and then at some of the types of starches and starch derivatives which are commonly used. Surface sizing of paper and board is, as the name implies, a treatment applied to the paper surface to improve finish, produce a surface better suited to printing, minimize scuffing, control densometer, prevent excessive or undesirable penetration of other finishing agents, decorate or improve appearance, and improve strength characteristics. The amylaceous products used in the above operations are of many different types and are oftentimes used in combination with a host of other naturally occurring and synthetic film-forming products.

TYPES OF STARCH PRODUCTS USED

Generally speaking, we might divide the starch products used in surface sizing into several groups as follows: (1) enzyme converted starches, (2) medium to high fluidity thin boiling starches, (3) low soluble dextrines and gums, (4) oxidized starches, and (5) starch derivative and chemical condensation with other products.

Enzyme Converted Starches

The enzyme converted starches are used to an appreciable extent in tub and size press sizings. Their usage on board calenders seems to be pretty much limited to some scattered application on fourdrinier board. In fact, some of the large southern fourdrinier board manufacturers use 2 to 3% concentrations of unmodified or native starch at rather high temeratures for laying surface fuzz. The enzyme converted starches are the least expensive of all the starches and are used more often on the lesser expensive paper products.

Thin Boiling Starches

Medium to high fluidity or low viscosity thin boiling starches are products which have been depolymerized, usually by an acid conversion, by the starch producer. These products seem to have been passed up by you manufacturers. Within the past year or two, a number of the starch producers have produced products of the class which are now having very good acceptance. Such products properly converted by the manufacturer cost but very little more and sometimes less than enzyme converted starches. They have an advantage over the enzyme converted starches in that they require no carefully controlled preparation and, more important, the thin boiling starches are more uniformly depolymerized than the enzyme converted starches. These products, in addition to being more competitive with the enzyme converted starches, are oftentimes used to replace at considerable savings some of the higher priced oxidized starches and chemical starch derivatives. In short, some of the specially tailored thin boiling starches fit very advantageously into the sizing of medium to high grade paper and board production.

Low Soluble Dextrines

Low soluble dextrines are depolymerized starch products resulting from a torrefaction process. Their solutions exhibit low viscosity and, therefore, may be used in high concentrations. In cases where an appreciable amount of subsurface penetration or a high added weight is desired, the low soluble white dextrines should be considered. They are slightly more expensive than the thin boiling starches. A dextrine for usage in surface sizing should be converted by the manufacturer to have a good white color and be produced in such a manner that the dry roasting or torrefaction results in a product which produces a uniformly depolymerized product. Quick converted dextrines, like enzyme converted starches, usually contain a mixture of products ranging from reducing sugars to very slightly depolymerized starches.

Oxidized Starches

Oxidized starches are often referred to as chlorinated starches. These products, as the name implies, are produced by the starch manufacturer by treating a slurry of starch with hypochlorite. The conversion is a rather slow and carefully controlled one, and products result which are very uniformly depolymerized. The oxidized starches produce solutions with improved colloidal properties and are excellent film formers. They have been extensively used on the better grades of rag or bond papers. They are produced by the majority of the starch manufacturers in a number of fluidities so that surface sizes ranging from 3–4% to 20–25% are possible.

Chemical Condensations

Chemical condensations of starch products with materials like alkaline and acid setting synthetic resins, sodium salts of fatty acids, and three-way condensations of starch, resin, and polyvinyl compounds produce some very interesting and

useful surface sizes. Our reacted starch process, patent no. 2,450,377, describes a starch-urea formaldehyde product which may be used to produce wet strength, washable coating, and high wet scuff resistance. The du Pont Co. recently obtained a patent on a condensation between an amylaceous material and a triazone. This is United States patent no. 2,641,584 which is reported to produce, among other things, a wet-strength surface size. Materials such as polyvinyl alcohol, since they undergo a condensation with urea formaldehyde resins quite similar to reactions with starches, are used to good advantage with starches and resins. Surface sizes prepared with these three products according to United States patent no. 2,450,377 produce a tub or calender size which assures exceptionally high wet and dry scuff resistance.

Starch products may be condensed with alkaline setting resins of the ketonic or modified resorcinol types. Our patents nos. 2,626,934 and 2,650,205 describe such condensations. Due to the highly colored nature of resorcinol resins, they have but little application as surface sizes. The ketonic resins being water-white may be used on either white or colored paper surfaces. Surface improvements similar to those obtainable with acid setting urea formaldehyde resins are realized. One advantage of surface sizes produced from starches and alkaline setting resins is that they are considered to be more permanent and very resistant to attack by mold and mildew.

Starches may be reacted and coupled with salts of fatty acids or soaps. Such a condensation is described by our United States patents, nos. 2,121,502 and 2,124,372. While the preliminary usage of starch-soap reaction product is in connection with effecting high retention of cooked starch at the wet end, it is also used with sodium or calcium soaps in surface sizing solutions to impart high finish on bristol, index, and card stock.

Surface sizing starch solutions are also compounded or mixed with a large number of other film-forming materials some of which are latices, polyvinyl alcohol, polyvinyl and polyethylene emulsions, carboxymethyl cellulose, guar, locust bean gum, paraffin wax, wax emulsions, a large number of plasticizers, and proteins. The suppliers of starch and these other materials cooperate with each other and finishes of almost any kind are possible with such combinations.

Starch Derivatives

Starch derivatives are products in which organic or inorganic substitution has been chemically effected directly into the starch molecule. Such products as allyl starch, carboxymethyl starch, hydroxyethyl ether starch, and starch esters containing both carboxylic and sulphonic acid groups have been developed by the starch industry. Most of these products are on the market today, and some of them are available in any quantity. Some of the starch ethers and esters cost very little more than the oxidized starches. As a result of direct chemical substitution into the starch molecule, both chemical and physical properties are changed. These new products are today finding wide acceptance in the paper industry, particularly in surface sizings.

The application of fundamental chemical synthesis by the starch industry opens up an entirely new field. Products having properties long desired by the paper and other starch consumers are now not on the horizon but are actually here. It is, perhaps, too early to predict just how far this important development may change the present practice of surface sizing. However, I believe one can safely say that paper surfaces will be produced with properties heretofore not realized.

After sketching the reason for surface sizing and some of the starch products employed, I would like to take the remainder of the allotted time to discuss some of the locations on machine where surface sizing is applied and the specific properties imparted to the sheet surface.

LOCATIONS ON THE MACHINE WHERE STARCH I APPLIED

Sizing at Wet End

Surface sizings are applied in a relatively few mills at th wet end. Applications at or near the dandy roll and at th first press are examples. Glassine is sometimes sized b means of a set of nip rolls just before the sheet contacts th first drier. Sizes are applied by patented applications on c near the dandy roll. The size may be either sprayed c allowed to cascade onto the wet web. In general, it has bee the contention that sizes applied here would have to be ver fluid and very low in solids. The web contains a high per centage of water at this point and the application of a siz which is already very dilute would seem to the writer to b going in the wrong direction. I feel that a high solids sizin compounded to prevent sticking on the driers would be th more logical approach. I know there is some activity alon these lines going on today and have suggested recently t several manufacturers that some of the new starch deriva tives might well have application. Starch derivatives of th hydroxy ethyl ether type may be suspended in concentra tions up to 40% solids and are very fluid. Some of thes starch ethers do not swell in cold water but do completel paste at temperatures of around 135°F. It would therefor seem possible to apply any concentration of the suspensio and obtain very effective gelatinization on the driers whil there is still sufficient water in the sheet to allow for excellen filming of the size over the fiber surface. Undoubtedly some antiblocking agent would be required to prevent stick ing to the driers and felts.

Sizing at Smoothing Press

To the best of my knowledge, paper and board are not ofte sized at the smoothing press. At most mills, the sheet i about 50% dry as it enters this press, and the press proper in many cases, is similar to the conventional size press excep it does not have a size pan beneath the rolls. While doing some work in connection with wash or size press coating recently, we did apply pure starch and pigmented starc sizes at the smoothing press. A precoat may be applied her which, when overcoated at the size press, offers advantage over one pass coating, particularly on an unbleached sheet The application of a suspension of a starch derivative of proper gelatinization temperature might be applied here to advantage. In this way, the surface is sized or coated before any great difference in density or hard spots are produced. We intend to do quite a bit more work with surface sizing applications at this point, and I am simply taking this opportunity to suggest that some of you who are equipped with a smoothing press give some thought to this project.

Sizing at the Tub or Size Press

Surface sizing and decorating or coating at the size press is a subject about which we could quite possibly spend the balance of the time and then not cover it completely. It is at this location where the majority of surface sizing is accomplished on both paper and board. The sheet enters the tub or size press at an average moisture optimum content of 5 to 12%. Pure starch sizings are employed in concentrations of from very low to over 25%. The sheet is usually quite receptive to absorbing size here and may be internally sized by use of a penetrating starch solution, or the surface may be altered by use of the less penetrating type of film-forming starch products.

A small percentage of pigment, dyestuffs, etc., has been incorporated with starches at the size press for a very long time. It has, however, been of recent years that pigmented sizes in which the pigment represents by far the greatest percentage of the size were adopted.

The composition of size press coatings is not materially

different from either on or off machine true pigmented coatings, as far as ratio of pigment to binder is involved. Regular starch products due to their rheological and fairly low suspending properties in dilute or low viscosities have not been used too successfully. With the advent of some of the newer hydroxy ethyl ether starch derivatives discussed briefly above, this operation is today assuming a place of considerable importance in the paper and board industry. We have in the past two years developed size press coatings with clay, titanium dioxide, other pigments, and hydroxy ethyl ether starches. These coatings which are applied on a standard size press may vary in solids from 15 to 45% with the binder usually about 25% based on the pigment.

The coatings, some of which may contain dyestuff, are used on both paper and board. The coated paper may be bleached sulphite or kraft and may contain an appreciable amount of groundwood. It is sold directly off the paper machine as offset grade and printed in single or multicolor offset presses. The appearance, printability, brightness, and opacity are substantially improved. Some regular brown kraft paper has recently been coated with these formulations, with and without added dyestuffs.

Board such as bleached kraft is being regularly size press coated and finished on the calenders with as many as four water boxes.

Coating weights on 40 to 80-lb. paper have been produced, ranging from 4-lb. to as high as 20-lb. per ream. A coat weight of 6 to 8-lb. per ream represents the greatest tonnage produced. With weights of this magnitude, it is unnecessary to employ any waterproofing agent. It is difficult to remove any of these coatings even with vigorous scrubbing. For the higher weight coatings, it is advisable to use either resins or latices with the starch to improve the wet rub.

The deposition of a smooth uniform coating at the smoothing press and/or at the size press opens up an entirely new field for many mills. Those mills which also coat paper and board can improve quality by coating at the press with an undercoat and overcoating with the regular coating. In many cases, this would result not only in a more uniform coated sheet but one of lower cost. If we also consider the field of coating or decorating regular brown kraft paper and board with white or colored coatings, the operation could well be of tremendous proportions. By using a size press coating of titanium dioxide and high brightness clay, one could reduce the amount of expensive titanium dioxide added to the furnish which, in addition to lowering cost, would improve strength. Some producers who have to size at the press for strength are now using size press coatings in which the ratio of pigment to binder may be 1 to 1 or 1 to $1^1/_2$, instead of the more standard 4 to 1 ratio.

Sizing Off-Machine

Some of the lighter weight paper may be surface sized off the machine and allowed to wet pack or cure for several hours, after which it is usually air dried. The size may be applied by means of a dampening roll or the size may actually be sprayed onto the sheet surface. Care must be exercised in the operation to employ a size preparation and concentration which will not block in the wet roll.

Sizing at the Calenders

Paper of basis weight below 80-lb. is not generally surface sized at the calenders because of the danger of picking and, also, because such low basis weight papers cannot absorb the moisture and do not have sufficient residual heat to cause an appreciable loss of moisture between the calender and reel. Higher basis weight papers and board are, therefore, the only grades which are surface sized at the calenders. In many cases, the same size which is used at the size press is also used on the calenders. Generally speaking, one can employ a higher viscosity at the press than on the calenders. There are times and specific applications where it may not be desirable to use the same size at both places. Depending on the results desired, it may be advisable to size at the press with a low viscosity size and at the stacks with a high viscosity. Such an arrangement might be very desirable if one wishes to close up and strenthen a sheet but not have an excess of size on the surface which may interfere with subsequent high speed gluing, etc.

Sizing the under side of board with 8 to 10% concentration of some of the newer starch derivatives at temperature of 185 to 200°F. is very effective for increasing burst. From 10 points to as much as 20 points increase in burst is obtainable with usages of 10 to 15 lb. per ton of 0.016 test liner. In this operation, the high temperature is very necessary to insure the optimum pickup and penetration of the size into the under or weaker side of the board. Some of the higher viscosity starch ethers have found excellent acceptance for surface sizing at the calender board which is later to be printed with high gloss inks. In this operation, it is preferable to employ the highest concentration of the lowest depolymerized starch ether at the lowest temperature which can be maintained conveniently on the machine. In other words, here we are setting conditions to insure the film-forming type of starch ether remaining on the surface.

Sticking, foaming, and roll corrosion or erosion are three conditions which may and often do cause a lot of trouble with surface sizing operations. However, they need not be the source of so much trouble if a few simple precautions are observed.

If a size froths or foams, it may be easily corrected by the judicious usage of any of the good defoaming agents on the market today. Foaming may result from some minor impurity in the starch as received or may result from a surface-active material being leached out of the sheet, itself. Sometimes, it is due to entrained air caused by faulty size pumping and agitation.

Sticking on the driers or on the stacks is a far more serious problem and may be due to a number of things. One of the most common causes is due to using a size at a viscosity level which causes jumping in the boxes. When this occurs, invariably some size is splashed onto the roll or drier surface, partially dries to a gummy state, and causes a break. First of all, one should determine that the size has reasonable viscosity and then make sure all mechanical precautions are taken to prevent splashing or cascading of size. If correction of the above does not eliminate the trouble, then an antiblocking agent may be advisable. Soap, wax emulsions, and polyethylene glycols are among the most common antisticking agents used. High titer soaps may be used, both as antiblocking agents and, curiously enough, as defoamers. All soaps, however, do markedly increase viscosity of starch solutions and may therefore be undesirable or not, depending on the type of size in question. All soaps also precipitate out of colloidal solution in the presence of hard water. I have seen numerous cases where the curd produced in hard water actually caused a marked corrosion or, perhaps, more correctly, erosion of calender rolls in as little as 2 weeks' time. Soaps and stable wax emulsions may also decrease the wettability or increase the water drop time. On some boards, this is quite desirable while on others, such as, for example, on folding carton stock, it is quite unwanted. Polyethylene glycols or such products as sold under the name of Carbowax are excellent although somewhat more expensive antiblocking agents. The higher polymers such as Carbowax 4000 or 6000 have the appearance of paraffin wax but are completely soluble in water and insoluble in wax solvents. They do not combine with hard water salts and do not increase starch viscosity. Since these glycols are water soluble and fat or oil insoluble, they may be used to advantage as antiblocking agents for board on which one does not wish to increase water drop test and wishes as much grease resistance as possible.

Pitting or corrosion of calender stacks is a condition which

has been before paper producers ever since size of any type has been recirculated over acidic board. This cause of pitting may be very effectively combatted by using a buffered size. In addition to making harmless any acidity picked up by the size from the paper, there have been cases where pitting was still encountered with a neutralizing size. I have referred briefly above to roll damage caused by scum originating from reaction of soap with hard water. The use of both oxidizing and reducing agents has been of benefit at a number of mills. Sodium nitrite and sodium sulphite are commonly used. Sodium dichromate when used in the amount of 2 to 6 oz. per 150 gal. of size has been effective for a number of years at several mills that had severe corrosion problems. The only difficulty with the chromate salts is that they are highly colored and therefore not usable on white board.

EFFECT OF MACHINE AND STOCK VARIABLES ON SURFACE SIZE

Some machine characteristics and stock furnishes vary widely, and let us consider the effect some of these variables have on surface sizing. The first variable to consider is moisture of the sheet as it comes to the press. Maximum absorption of size is realized when the moisture is between 5 and 12%. At levels both below and above this, less size is picked up by the sheet as it goes through the press.

Viscosity, temperature, and the time of exposure before entering the nip have a pronounced effect on size pickup. Penetration of size has been reported to vary inversely as the square root of viscosity. Viscosity also varies directly with temperature. The longer the size is exposed to the paper surface, the greater the size absorption.

Internal sizing of the sheet, sheet density, and smoothness are three other variables which regulate the size pickup and location of size with reference to sheet surface. As may be expected, increased size content and density will adversely affect the amount of size absorbed. Usually the higher the smoothness the lesser the size pickup. This is the case because the sheet with protruding fibers will actually act as wicks for the size.

The nip pressure at the press has a bearing on how much size may be squeezed into a sheet or, with the more viscous sizes, how much may be squeezed off the sheet. The hardness of the size press top roll, the angle at which the sheet enters and leaves the press, and the condition of the press roll surfaces all have a definite bearing on size pickup.

The molecular size of the starch micelle or, saying it another way, the degree of starch depolymerization is a variable of importance. A mixture of high and low converted starches can and very often is responsible for actual classification in the size press nip. It is frequently noted that with continued circulation of size the viscosity increases above and beyond that which may be accounted for by any starch retrogradation or change in temperature or pH. In many cases, this could be due to preferential absorption of unlike starch components.

A very general statement with proper consideration of the above variables might be made to the effect that under similar conditions a fairly constant gallonage of size is picked up regardless of the type of size under consideration. The solids or actual size content will, of course, vary with the concentration.

Surface size applied at a tub, due to the longer time of exposure will, under identical conditions, show higher consumption than in a size press, and a size press will usually involve under the same conditions about twice the pickup at the calenders.

Now, since the gallonage of size pickup at the press or calenders is constant on the same grade of board and with similar viscosities, it is quite imperative to give consideration to the amount of solids pickup and location of this size. High viscosity sizes may be expected to remain at or near the surface. Low viscosity sizes which are most often used in the higher concentrations will penetrate further into the sheet until such concentrations are realized that a penetrating type of size will also act quite similar to a high molecular weight or high viscosity size.

Starches Tailor-Made for the Paper Industry

T. A. White

For many years starch has been of importance as a binder, adhesive, size, or finishing agent in the manufacture of papers. The starches and starch products used have been many and varied. Any review of what is new in starches for the paper industry should start with the older, standard types. We should keep in mind that what is commonplace today was new only yesterday, and what is new today will be commonplace tomorrow. Moreover, we should not forget that many times an old, standard product may be just the thing for some new use tomorrow. Starches, then, should be considered broadly and used where the individual properties fit them for best results.

T. A. White, National Starch Products Inc.

Starch is a white, granular material that comes from the seeds, piths, or roots of plants. When the natural starch has been extracted it is known as raw starch. Different methods are used to separate the various starches from their plant materials, but all these methods follow the same general pattern. First, the plant is cleaned. Next, it is ground, soaked, washed, sieved, and filtered. The starch granules are recovered from the filters in cake form. The filter cake is then washed and dried to produce commercial raw starch.

Table I

Starch	Cell size, mu	Temperatures (°F.) at which gelatinization begins: 5% solution	33 1/3% solution	Starch paste: Texture	Starch paste: Clarity
Corn	10 to 25	176	156	Jel	Opaque
Amioca	10 to 25	165	162	Cohesive	Slightly clear
Tapioca	10 to 35	145	136	Cohesive	Clear
Sago	15 to 70	165	160	Soft cohesive	Slightly clear
Potato	15 to 100	147	142	Soft cohesive	Very clear
Wheat	5 to 45	170	140	Soft	Cloudy

Each plant produces starch which appears under the microscope in uncooked form as a cellular or granular material. The cellular structure varies from one plant source to another. The raw starches which have been found of commercial interest to the paper industry are those extracted from corn, tapioca, potato, waxy maize, wheat, and sago. Figure 1 shows the various microscopic appearances of these starches.

STARCH TYPES

Just as each of these starches appears differently under the microscope, so do they also come from different places and possess a variety of properties. Table I sums up the main properties of these commercial raw starches and includes their estimated average granule size as well as the

T. A. White, Chief Chemist, General Laboratory, National Starch Products, Inc., New York, N. Y.

average temperatures at which they start to gelatinize at two different concentrations in water. The following brief review will cover other interesting individual properties.

Corn

Corn is the greatest single source of commercial starch. Most of the world's cornstarch is manufactured in the United States, mainly in the corn-growing regions of the Midwest. It is the base for more specialty starches and converted products than any other starch. This ready availability, and at prices which are relatively free of wide fluctuations, has had its appeal to paper manufacturers especially in the United States. Under the microscope cornstarch appears as an angular, relatively small, celled granule. When raw cornstarch is cooked in water, the solution is cloudy, noncohesive, and upon cooling has a tendency to paste and set to a fairly firm jelly at a concentration of 8%.

Tapioca

Before World War II, tapioca was imported largely from Java. Since that time, Brazil has been the principal source of tapioca. During recent years the price of tapioca has been higher, with the result that smaller quantities have been used by paper mills. However, medium grade tapioca flours from Java became available in 1953 at prices competitive with domestic starches. Tapioca is extracted from the root of a tropical plant called cassava or manioc. Under the microscope the granules appear as truncated spheres resembling in some cases a kettle drum. An 8% solution of tapioca cooked in water is a fluid semiclear, cohesive, or rubbery material at room temperature.

Potato

Although sizable quantities of potato starch are manufactured in the United States, it is not as plentiful relatively as in Europe. Production in the United States is concentrated in the potato growing regions of Maine and Idaho. Domestic potato starch is equivalent in quality to the imported grade. Both types are used. Potato starch granules, under the microscope, are oval in shape and larger than those of any other commercial starch. An 8% solution of potato starch cooked in water is quite viscous at room temperature and has a semiclear appearance with a cohesive, rubbery texture or flow.

Waxy Maize

Amioca, the starch extracted from waxy maize, has become of commercial importance since World War II. It is produced in the United States in limited quantities as part of a special agricultural program. Waxy maize grain looks like ordinary corn grain. The starch granules extracted from both grains are identical in appearance under the microscope. The starches, however, are quite different. While cooked cornstarch solutions are unstable, and set to a firm paste at room temperature, cooked solutions of amioca are stable, semiclear, fluid, and cohesive.

Wheat

In the manufacture of wheat starch, the main problem is to remove the relatively large amount of protein which is present in the grain. Because wheat protein itself is of commercial value, wheat starch in many cases is obtained as a by-product. Wheat starch granules vary widely in size. Some are quite small and round. Others, though not oval in shape, are as large as some potato granules. An 8% cooked wheat starch paste is cloudy to opaque, only slightly cohesive or gelatinous and soft in texture at room temperature.

Sago

Sago starch is refined from sago flour which is obtained from the sago palm that fluorishes in low marshy areas of the East Indies. Sago flour is not obtained from the root nor the fruit of the palm tree, but is taken from the trunk of a mature sago palm. Under the microscope the sago granules appear as large oval-shaped cells which have in some cases an irregular truncated shape. An 8% solution of sago starch cooked in water has a semiclear somewhat cohesive and fluid appearance at room temperature. Commercial raw sago starch is normally not cleaned up or refined and is off-color in appearance.

INDUSTRIAL MODIFICATION

You have just seen how raw starches offer a wide variety of starch properties. Nature has tailor-made starches with many different combinations of properties for her own use. All raw starches, however, are what might be called thick cooking types, and thinner, lower viscosity, types are often preferable. Many industrial applications call for still other properties not found in raw starches.

To meet the need for a greater variety of special starch properties than nature provides, starch refiners have improved upon nature. A number of these converted or processed starches are almost as well known as the raw starches themselves. A quick review of these types should help complete the picture of what might be considered available standard materials.

Thin boiling or fluidity starches were among the earliest types to be prepared in the United States in a range of viscosities. They are manufactured in large part from corn. The raw starch is converted, while suspended in water, in the presence of a small amount of acid and at a temperature below the gelatinization point. It is believed that the acid treatment preferentially tends to break the branched amylopectin molecules. As a result, pasting or jelling characteristics of the linear amylose type molecules become more predominant. In other words, these types of starches may be cooked at higher concentrations in water without obtaining more viscous solutions than would be obtained with raw starches. On the other hand, they tend to form firm jellylike textures when the cooked solutions cool. Temperature control while such solutions are being used is important because the viscosity normally changes quite rapidly with temperature.

Thin boiling starches may also be prepared by means of oxidation, such as with sodium hypochlorite instead of acid. It is believed that sodium hypochlorite, unlike acid, acts more uniformly in breaking both amylose and amylopectin molecules. In addition, hypochlorite introduces, by oxidation, solubilizing carboxyl groups into the molecule that increase the stability to jelling. Several different starches have been converted on a commercial scale by the oxidation process.

Their availability varies somewhat with the changing economic picture. In all cases, the solutions of the oxidized starches are clearer, more stable, better film formers, and make stronger adhesives than their corresponding acid thin boiling types. The paper industry is a principal consumer of highly oxidized types for clay-coated paper as well as for tub and calender sizing.

Dextrins offer a third variety of converted starch types of interest to paper manufacturers. They are made by roasting dry starch under different conditions of temperature, time, and pH. Thicker cooking types of dextrins are commonly referred to as British gums. They are darker in color and as such are seldom used in the manufacture of paper. They are frequently used in the preparation of adhesives used by paper converters. The same is true of yellow dextrins which are the lowest viscosity types. They are primarily used where high solids solutions are required and are employed in the preparation of adhesives, especially where a remoistening gum is desirable, as in the case of gummed tape or labels. White dextrins, on the other hand, are of particular interest to paper manufacturers as the adhesive or binder for clay-coated papers. A lesser converted type of white dextrin

has about the same viscosity as a high fluidity thin boiling starch, and the properties of both resemble each other in many ways.

This completes the review of the more common or usual types of starch products, and it brings us almost up to date from a new starch development viewpoint. These products offer the paper manufacturer a wide variety of properties for use where starch can be of help. More recently, additional types have been offered in more or less commercial quantities and they have increased the variety of available starch products. A quick review of these should bring us up to date and give you a glimpse of what new tools may be available to you in the future.

Pregelatinized or cold water swelling starches have been used for many years for addition to beaters or headboxes. They have been used primarily to obtain increased strength in the paper, reduce the porosity, assist in the retention of fines, and improve the formation of the sheet. New manufacturing techniques, recently developed, combined with chemical improvements in the starch itself, have produced these types of products with qualities never before offered to the paper manufacture.

It is not uncommon to convert raw starches by means of enzymes for use in the size press, on the calenders, as the adhesive or binder in coating papers. The different starches convert differently with enzymes. In general, the root starches convert more easily than do the cereal starches. In all cases, the main problem is control of the process. Better enzymes and more elaborate systems of control have enabled paper manufacturers to obtain enzyme converted starches more suitable for their use. The process is still based largely on a pH adjusted regular starch. There does not seem to be room for much improvement in the present converting method. On the other hand, it may be possible to process the raw starch prior to enzyme conversion in order to obtain improved properties in the finished converted product. Such additional processing, of course, would make the base starch cost more and it is a question of economics as to whether or not the improved results would justify the additional cost. The main thing is that it does offer a new approach to this important use for starch.

Cooked solutions of starches usually are sensitive to temperature changes, agitation, and pH. This fact is frequently overlooked by users of starches. As production speeds increase and circulating systems become more common, these characteristics assume greater importance. More recently it has been possible to reduce viscosity and texture variations that plague the paper manufacturer. This has been done in many cases by the cross-linking of starch molecules to reinforce, so to speak, the starch structure in order to make it more resistant and more stable to chemical and physical forces.

Still more recently it has been found that the addition of new groupings or radicals to the starch molecule offers a means of producing starches with really unique properties. These are low substituted starch derivatives and are still soluble in water when cooked. Most of them are of the ether or ester type. Some of them which already have become of more or less commercial importance are the acetates, hydroxy ethyl ethers, and the carboxymethyl ethers. These types of products in solution form are better film formers and usually are more stable to temperature changes. They offer the paper manufacturer a number of new tools in his sizing or finishing of paper.

We might consider the idea of chemical derivatives of starch still further, and peer a little into the future. When the substituent group terminates in an acid radical, such a product offers a variety of possibilities from a new property viewpoint. The sodium or ammonium salts of the derivatives, for example, tend to have excellent affinity for water and their solutions are clearer, more fluid, and stable. On the other hand, if the salts are of polyvalent metals, the starch product loses much of its affinity for water and offer a possibility of semiwater resistant finishes or coatings. This, of course, is from a chemical point of view and the mechanic of processing the paper in order to obtain those effects sti must be developed.

Looking even further into the future, there is a possibilit of starch products with unusual film-forming characteristics We know that most starches are combinations of two type of molecules: the branched or amylopectin type, and th straight-chained or amylose type. Starch from waxy maiz is commercially pure amylopectin and it offers a variety o characteristics not found in other starches. No commercia source is available at this time for essentially pure amylose It has been shown experimentally that amylose is an excel lent film-forming material. Starch chemists are makin considerable progress in the development of starches of th amylose type. This is not something for the present, but i is something that the paper manufacturer might keep i mind in his long range plans.

This completes our review of the basic starches, the mor common processed and converted starches, as well as a glimps of what new types probably will be available in the nea future. It will not take a crystal ball to show that starc chemistry is on the march. Many new approaches are bein investigated and special starches with unique properties ar in various stages of development. Just as nature has tailor made her starch molecules to the various needs of growin plants, so starch chemists are endeavoring to redesign or refi starch molecules which nature supplies in such abundance t the requirements of modern industry. Development-minde chemists and chemical engineers can, therefore, look forwar to a busy future with new starches.

Meeting of May 11

The Ohio Section of TAPPI concluded a busy and success ful year with its second annual ladies night banquet an dance. The meeting, held at the Hartwell Clubhouse of the Cincinnati Gas and Electric Co. on May 11, brought together about 300 members, wives, and guests for an evening of socia activity, to climax a season of technical sessions covering al phases of papermaking.

The meeting started with a cocktail hour sponsored by Shartle Brothers Div. of The Black-Clawson Co. during which time background music was supplied by Fred Lindeman on the accordion. After dinner, officers for the coming year were elected and past officers were congratulated for a fine season.

Chosen to lead the Ohio Section during the next year:

Chairman—Harold R. Joiner, Champion Paper & Fibre Co.
Vice-Chairman—Wm. H. Aiken, Gardner Board & Carton Co.
Recording Secretary—Wm. Petrich, Howard Paper Mills Co.
Corresponding Secretary—Donald Jenkins, Champion Paper & Fibre Co.
Treasurer—George B. Gregg, Cincinnati Gas & Electric Co.
Executive Committee—John L. Clouse, Oxford Miami Paper Co.; C. E. Brandon, Howard Paper Mills; Herbert A. Smith, The Mead Corp.; Donald J. Goodman, Sorg Paper Co.; George B. Gregg, Cincinnati Gas & Electric Co.; John Nolan, Sorg Paper Co.

There was a dance which continued until midnight. At intermission Marian Spelman, noted Cincinnati vocalist, radio and TV entertainer, gave the group a very entertaining half hour.

This meeting marked the end of the 1953–54 season. Plans are already being made for programs to be presented during the next season. Ohio TAPPI looks to the future with anticipation as well as to the past with pride.

Kalamazoo Valley

The Kalamazoo Valley Section of TAPPI met May 6 at the Hotel Harris in Kalamazoo, with 75 in attendance. J. A. Dean, vice-president, presided and was in charge of the pro-

gram. On behalf of the Local Section he awarded a scholarship of $100 to Charles Elliott, Battle Creek, Mich., as the Western Michigan College paper technology student having the highest scholastic average for the first 3 years of enrollment.

Mr. Elliott acted as master of ceremonies during the next portion of the program, in which he and eight other Western Michigan College Paper Technology Department seniors gave brief progress reports of their senior problems as studied in the course "Research Problems in Pulp and Paper." The main objectives of this course are, first, to acquaint the student with the nature of research and, second, to teach some of the techniques of research, with special emphasis upon literature surveys, report writing, and planning of experimentation. Actual experimental work is limited to the second semester, and this course is carried as part of a full academic schedule.

Titles were as follows:

Hugh Burnie, Fort William, Ont., "The Loss of Some Strength Characteristics of Coated Magazine Paper as a Result of Exposure to Elevated Temperatures."
Miguel Cabrera, Puerto Rico, "The Influence of Pith Cells on the Papermaking Characteristics of Extracted Sugar Cane."
Kent Dickerman, Wisconsin Rapids, Wis., "Acid Treatment of Pulp, and the Resultant Changes in Physical Properties."
Ronald Hamilton, Kalamazoo, Mich., "The Effect of Varying Alumina and Hydrogen Ion Concentration on Strength Characteristics of Handsheets Formed from Pulp in Presence of Locust Bean Gum, II."
Ted Jewson, Otsego, Mich., "A Comparison Between Sodium Hypochlorite and Sodium Hypobromite as Single-Stage Bleaching Agents at Varying pH Levels."
Donald Thornton, Kalamazoo, Mich., "Possible Use of Chlorine Dioxide in Bleaching Deinked Paper Stock."
Robert Walker, Petosky, Mich., "Variables of Supercalendering, II."
Andre Breton, Rouen, France, "A New Experimental Pulp Digester with Separate Steam Supply."
Charles Elliott, Battle Creek, Mich., "Fiber Length as a Variable Influencing Wet Strength."

The evening's program was concluded with a showing of the American Cyanamid Co. moving picture, "Life with Paper," adapted from the television show which first appeared during Paper Week this year.

R. T. Elias, *Treasurer*

LETTERS TO THE EDITOR

Barium in Water

To the Editor, *Tappi:*

I am looking at TAPPI Standard, T 620 m-52, "Analysis of Industrial Process Water," and notice that the analytical method concerned apparently does not say anything about the determination of barium. This does not surprise me because I, myself, would never have thought of looking for barium in any potable or industrial waters until recently when we encountered some troublesome scale deposits containing considerable barium sulphate. The source of this barium sulphate has not yet been established definitely.

Apparently, "Standard Methods for the Examination of Water and Sewage," 9th ed. (1946), American Public Health Association, also contains no method for the determination of barium.

Have you any suggestions where we might be able to obtain information in this connection, that is, not only regarding methods for determining barium when present in small quantities in waters, but also information concerning the presence of barium compounds in natural waters and the sources from which the barium compounds might get into such natural waters?

A. W. Pesch
International Paper Co.
Mobile, Ala.

To the Editor, *Tappi:*

Rapid and convenient methods for barium in the small concentrations expected to be present in natural water have not received a great deal of attention. Because most waters contain sufficient sulphate to precipitate barium, the barium ion is rarely found in natural waters. The barium ion therefore is not usually of great significance in water analysis except in connection with water flooding operations for oil production where precipitates of barium sulphate prove troublesome.

The American Water Works Association has developed rapid tests for the detection of toxic materials in water and the following is a quick test to determine the presence of barium. The only reagent used is 50% by volume sulphuric acid.

The procedure is to place 5 ml. of the text sample in a test tube and an equal quantity of the blank in a second test tube. To each add 1 drop of 50% sulphuric acid, shake, and let stand for at least 10 minutes. Then hold tubes over a dark surface and look down through the tubes. The blank should be clear and any turbidity in the test sample will indicate the presence of barium.

The test has a sensitivity of plus or minus 5 p.p.m. barium. A considerable excess of sulphate ion is necessary to precipitate a trace of barium. Conversely, a considerable excess of barium is necessary to precipitate a small amount of sulphate. About 500 p.p.m. sulphate ion is necessary to produce a noticeable turbidity with 5 p.p. n. barium. This sulphate concentration is in excess of that found in most water supplies which means that barium could be introduced without visual detection.

The above is simply a quick test to determine appreciable concentrations of barium. However, barium in lower concentrations can be determined nephelometrically by an adaptation of this same idea which is a reversal of the method usually employed for the determination of small amounts of sulphate. The procedure described in Snell's "Colorimetric Methods of Analysis," D. Van Nostrand Co., Inc., New York, N. Y., page 467 (1936), has been used in our own laboratories.

Other procedures are given in Sandell, "Colorimetric Determination of Traces of Metals," Interscience Publishers Inc., New York, N. Y., page 150 (1944).

We are also enclosing a copy of a gravimetric procedure for the determination of barium. This is the method as used by the U. S. Geological Survey.

William A. Tanzola, *Assistant Director*
W. H. & L. D. Betz
Philadelphia, Pa.

Metal Hydrometers

To the Editor, *Tappi:*

Would you be good enough to inquire from TAPPI members whether there is any experience of the use of corrosion-resistant metal hydrometers for testing kraft black liquor. At the present time we use glass Baumé hydrometers in three ranges, 0–15°, 15–30°, 30–45°, and the breakage rate is very high.

It is our opinion that a metal hydrometer with a reasonably long scale would be a big improvement on the glass hydrometers and we would greatly appreciate any information concerning instruments of this kind.

From our study of the literature it would appear that Hastelloy 161 would be a suitable metal for the manufacture of these hydrometers.

A. W. Mackney, *Chief Chemist*
N. Z. Forest Products, Ltd., Aukland, N. Z.

To the Editor, *Tappi:*

We use glass hydrometers in the ranges of 0–11°, 0–25°, and 25–50° Baumé and have never had any experience with metal type hydrometers. Our main difficulty with glass hydrometers has been with them getting off calibration. After long service they sometimes decrease in weight due to use in alkaline liquor which gives a high reading. Also the scales in the stem have come loose giving erroneous Baumés by slipping up or down stem slightly.

At all of our test stations we have racks for placing hydrometers and to date we have not had excessive loss from breakage. I know of no reason why a metal hydrometer should not be satisfactory except for high initial cost, but it would be interesting to learn more on this cost comparison.

Roy Homans, *Development Engineer*
Brunswick Pulp & Paper Co., Brunswick, Ga.

To the Editor, *Tappi:*

Replying to your letter dealing with the possibility of using a metal Baumé hydrometer in testing "black liquor" as used in the paper industry and as suggested by New Zealand Forest Products, Ltd., we submit the following opinion:

First: the instrument will have to be of a metal not acted upon by the solution in question (in all probability stainless steel).

Second: the gage of the metal would have to be very thin consequently subject to "dents" should it accidentally be dropped and thus affect the reading. Further, the metal being quite thin the graduation marks could not be etched very deep and in which event these could readily become filled with any inert material that might be present. All this together with poor lighting facilities, would make reading most difficult.

Third: the cost of producing the same would be very high, around 12 to 15 dollars each. Taking the cost into consideration it would seem the breakage factor as applied to that of glass would not be too serious. Finally, there is practically no demand for all metal hydrometers.

F. Arndt
Fisher Scientific Co.
New York, N. Y.

EMPLOYMENT SERVICE

Positions Wanted

E269-54. Pulp and Paper Graduate. Twelve years' experience in product and machine development, process design, and management. Seeks change with progressive concern.

E270-54. "Mill Manager, seeking for more challenging opportunity with a progressive concern, desires change. Engineering graduate (Ph.D. European University). Principal European languages. Twenty-five years' practical and theoretical experience in: manufacture of bond, newsprint, kraft, wrapping, and special papers; in groundwood and pulp (from fir and straw) production; in paper converting (industrial bags and stationery).

"Broad background of managerial position in both maintenance and production department; strongly inclined to plan developments. Capable of taking full charge of operation as Technical Director or General Manager (or equivalent executive position). Now located in Italy. Disposed to emigrate everywhere."

E271-54. Chemical Engineer: Broad background in wood research, coarse fiber processing, structural laminates, molded plywood, cellular core materials, fiber microscopy, original research in wet process and resin bonded hardboards. $5\frac{1}{2}$ years' industrial experience, 1 managing 30-ton foreign insulation board plant. Have initiated and lead product development programs.

E272-54. Paper Chemist. 30. Married. Five years' experience in the pulp and paper field. Graduate of New York State College of Forestry. Desires more responsible position on technical staff of progressive mill. Familiar with wide variety of paper grades and chemical applications.

E273-54. Presently employed technical and general paper mi desires position as paper machine clothing salesman or servi engineer. Extensive experience with both felts and wires.

E274-54. Chemist. Married. Experience in general mill prol lems, process and technical control, felt and wire problem Presently employed.

E275-54 Chemical Engineer. Graduate of Pulp and Pape School desires new position. Experienced in managemen product development application, and sales.

Positions Open

WANTED
Chemist or Chemical Engineer

Opportunity available for Chemist or Chemical Engineer in a mill making Bleached Soda and Sulphite Pulp, also Chlorine and Caustic. Mills located in Maine. Send résumé of educational background and experience. Experience desirable but not necessary. Address reply to Penobscot Chemical Fibre Company, Great Works, Maine. (P377-54)

P369-54. Chemist or Chemical Engineer with experience i paper chemistry, laboratory scale production, and evaluation Give full details of experience with reply.

P378-54. Assistant Engineer. Excellent opportunity for graduate engineer in the expansion program of a progressiv Wisconsin mill. Age 25–35. Pulp and paper mill experienc necessary. We invite inquiries and detailed résumé.

P379-54. Sales Engineer, C.E. or M.E., to sell and service nev type paper and board converting machine. Must be free t travel extensively in the United States. Immediate relocatio not necessary but is a future possibility. Send résumé statin salary expected to Earl E. Johnson, Oliver United Filters, Inc. 2900 Glascock St., Oakland 1, Calif.

P380-54. Experienced Coating Man. The Mead Corp. Researc Laboratory, Chillicothe, Ohio, has an opening for an additiona coating technician. Requires at least 5 years' experience i research and development phases of conversion and machin coating.

Must have advanced training or experience and be able to dea with fundamental aspects of color formulation and application All inquiries will be held in strictest confidence. Contact, R. L Warner, The Mead Corp., Chillicothe, Ohio.

P381-54. Young Chemist or Chemical Engineer with or without previous papermill experience to assist Chief Chemist in the Main Laboratory of a large integrated fine paper mill locate in Northern Wisconsin. Please give a complete résumé in th first letter.

P382-54. Converter of paper, films and foil used widely in indu trial packaging field, desires experienced man 30–40 as produ development and technical service project engineer. Must b capable of working smoothly with plant personnel as well a customers. Excellent opportunity established but aggressive growing company. Salary commensurate with experience Location east.

Miscellaneous

A7-54. FOR SALE: Leeds & Northrup SO_2 Analyzer, Recorder, and Controller. New and Unused. Write to C. S. White, The Racquette River Paper Co., Potsdam, N. Y.

Note: Responses to advertisements appearing in this column should be addressed to the box number indicated % *Tappi* 155 E. 44th St., New York 17, N. Y.

RECENT BOOKS

New Techniques for the Packaging Engineer. By Clemens Koehler, A. F. Deuble, and S. G. Stearns. Packaging Institute, 342 Madison Ave., New York 17, N. Y., 1954. Paper covered pamphlet 6 × 9, 23 pages. $1.25.

A series of three papers dealing with the work of the packaging engineer. "Maintaining Proper Packaging Specifications," by Koehler; "Quality Control Enters the Packaging Department," by Deuble; the "Packaging Faces and Incentive System," by Stearns.

Pocket Book of Chemical Technology. By V. Stannett, New York State College of Forestry, and L. Mitlin, Imperial College of Science and Technology. Chemical Publishing Co., New York, 1954. Cloth, $4^1/_4 \times 6^3/_4$ 283 pages. $4.75.

A handbook of chemical and chemical engineering data for laboratory and mill workers. Among the subjects covered are mathematical data, conversion factors, atomic weights, radioactive materials, properties of organic and inorganic compounds, gravimetric factors, buffer solutions, densities and specific gravities, fluid flow, heat transfer, boilers and fuels, materials of construction, average plastic properties, alloys, standard sieves, engineering data.

The Techniques of Supervision. By Alfred R. Lateiner. National Foremen's Institute, New London, Conn., 1954. Paperbound, $5^1/_4 \times 7^1/_2$, 207 pages. $2.00 (Cloth $4.00).

A management aid for first-line supervisors, covering such subjects as understanding and dealing with people, how to win cooperation, five ways to improve morale, discipline, accident control, how to train employees, how to simplify work methods.

Altpapieraufbereitung. By Heinz Mack. Dr. Sandig Verlag K.-G. (Helenestrasse 5), Wiesbaden, Germany, 1954. Paperbound, $5^3/_4 \times 8^1/_4$, 90 illustrations, 128 pages. DM 7,50.

Volume 1 of the Paper Technology Library is an excellent monograph (in German) on Waste Paper Preparation. It deals with such major subjects as sorting, cleaning, stock refining, and new preparation processes. Although the major part of the book deals with waste paper to be used for paperboard, some attention is given to deinking operations. A useful list of literature citations is appended to the text.

Industrial Specifications. By E. H. MacNiece, Director of Quality Control, Johnson & Johnson. John Wiley & Sons, Inc., New York, 1953. Cloth, $6 \times 9^1/_2$, 158 pages. $4.50.

Johnson & Johnson has acquired an excellent reputation in its use of statistical methods to arrive at its purchase specifications. The present volume by Mr. MacNiece is one of the first presentations of a practical manual which shows how a company actually arrives at its specifications.

The author first compares the accuracy of measurement to the ability to specify. He then stresses the careful relationship which should exist between technical and economic factors in production. Five chapters give the essential requirements for raw material, process and product specification. The final 60 pages are devoted to typical examples of product specifications, some of which relate to paper grades.

Mathematical Methods for Scientists and Engineers. By Lloyd P. Smith, Chairman, Department of Physics, Cornell University. Prentice-Hall, Inc., New York, 1953. Cloth, 6×9, 453 pages. $13.00

The author offers a wide range of mathematical methods employed in solving technical problems. For several years he gave a one-year course in mathematical methods for first-year graduate students and capable senior students in physics. The chief aim of the course was to provide a means by which a student could obtain a knowledge of the more important mathematical functions and their properties and the facility to apply the more important and useful mathematical methods to problems which he would encounter in theoretical and applied physics.

Among the subjects covered are calculus, space geometry, theory of functions, algebra, vector and tensor analysis, and elements of probability theory.

How to Control Production Costs. By Phil Carroll, Professional Engineer. McGraw-Hill Book Co., New York, 1953. Cloth, 6×9, 271 pages. $5.00.

The present book is considered by the author to be an extension of his earlier volume on "Time Study for Cost Control." He points out that in most plants the best common denominator is standard time. Stress is given to such tools of management as engineering, production control, suggestion plans, and quality control.

Among the subjects covered are: Why We Need Cost Control; Fallacies of Overhead Costs; Errors from Wrong Yardsticks; Manufacturing Is Conversion; What Measures Saleable Pieces ?; Setting Expense Budgets; What About Material Costs ?; How to Determine Conversion Costs; Variances; Break-Even Points; Start with Sales Forecasts; Production Control; Engineering Specifications; Control Is Taking Action.

How to Prepare an Employee Handbook. Issued by the National Foreman's Institute, New London, Conn. Loose-leaf Fabricoid binder, $8^1/_2 \times 10^1/_4$. $12.50.

The National Foremen's Institute issues a large number of publications relating to personnel relations. The present volume is a manual covering 578 subjects, including 1700 examples featuring actual policies of a large number of companies.

The first part of the book is devoted to company history, the employee's job, company policies, and legislation. The greater part of the manual is set up alphabetically. Under "A," for example, are such headings as absence from work, accidents, address change, adult education, advancement, admittance to plant, apprenticeship, athletic activities, automobiles, etc.

For individuals responsible for acquainting employees with information dealing with their relations to their company the manual is very useful and prepared in a convenient form which provides for additional information.

Modern Chemical Processes III. By the editors of *Industrial & Engineering Chemistry*. Reinhold Publishing Co., New York, 1954. Cloth, $8 \times 11^1/_4$, 276 pages. $5.00.

Volume III of "Modern Chemical Processes" is a compilation of articles of current interest that have appeared in *Industrial & Engineering Chemistry*. Among the articles of interest to the pulp and paper industry are the following: Animal Glue, Cellophane, Carboxymethycellulose, Chlorine and Caustic Manufacture.

Note: Books mentioned in this section may be obtained from The Technical Association of the Pulp & Paper Industry, 155 E. 44th St. New York, 17 N. Y.

Fundamental Research Conference

on the

Fundamentals of the Paper Machine

Appleton, Wis.

September 21–24, 1954

CORRUGATED CONTAINERS SESSIONS PAPERS

39th Annual Meeting of the Technical Association of the Pulp and Paper Industry
NEW YORK, N. Y., FEB. 16–17, 1954

The Easy Opening Box

The program of the Corrugated Containers Committee for the 39th Annual Meeting of the Technical Association was conducted in four half-day sessions. Tuesday morning, Feb. 16, was devoted to the easy opening box under the chairmanship of C. E. Jakeway, American Box Board Co., Grand Rapids, Mich.; Tuesday afternoon, high humidity containers, J. J. Koenig, Gaylord Container Corp., St. Louis, Mo., chairman; Wednesday morning, heat balance and its effect on corrugated board, D. P. McNelly, Fort Wayne Corrugated Paper Co., Hartford City, Ind., chairman; and Wednesday afternoon, general, John Fuko, River Raisin Paper Co., Monroe, Mich., chairman.

Application of Gummed Tear Tape on the Semiautomatic Taping Machine

FOSTER LOWERY

IT HAS been well demonstrated in the corrugated container industry, as well as in other fields, that seldom, if ever, does one piece of equipment or particular method of production dominate to the exclusion of all others. Perhaps all of us in the machine manufacturing business would like to be able to say that we have the only machine that can do a job, but in the final analysis, it is likely to develop that there are at least some kind words to be said for competing methods.

The best we can hope for is that a particular machine or method may prove to be the most desirable for a certain segment of work being performed, and this equipment will take its place alongside of other units as an essential portion of the complete facilities. We would say that this is definitely the case with the application of gummed tear tape on the semiautomatic taping machine.

It is well known there are two types of tape commonly being used for the quick opening feature on corrugated cartons. One is the pressure sensitive and the other the gummed tape which requires moistening and pressure for its final application. No doubt, both tapes will find a place in the packaging field. The semiautomatic taping machine at its present stage of development concerns itself only with the gummed tape.

Even for the application of gummed tape, the semiautomatic taping machine is not the only method available. It is, however, the best means for handling a particular type of business under certain given conditions. Where you are dealing with huge orders for boxes, perhaps for some nationally advertised product, the most highly mechanized method is likely to give the lowest cost. If the size of the order for tear tape boxes is smaller, however, the cost of complete automatic operation rises rapidly because the initial investment and the setup time cannot be justified. It is for this class of work that the semiautomatic taping machine is of greatest importance.

FOSTER LOWERY, Universal Corrugated Box Machinery Corp., Linden, N. J.

There is a vast field of packaging that will, no doubt, never require the application of tear tape. To the average box maker, this work must necessarily, for some time to come, represent a substantial portion of his output. It is not practical, therefore, for him to set aside special equipment and floor space specifically for the tear tape activity. He has a number of semiautomatic taping machines, and it is a relatively simple matter to assign one to part or full time work on tear tape. The cost of converting a semiautomatic taping machine to handle tear tape is nominal. No additional floor space is required to run the machine. The setup time is no greater than that required to set up a machine to tape a normal box. The operators are people who normally would be handling the regular run of taped boxes, and are fully familiar with the operation. Also, his cost estimates may be developed accurately from his standard taping figures.

To summarize, therefore, we can say that tear tape application on a semiautomatic machine is desirable in those plants where the size of orders is modest, the tear tape orders are not a predominant portion of the total output, and where quick setup, low initial investment, and conservation of floor space are essential.

To the best of our knowledge, most of the semiautomatic taping machines in use today can be converted to handling tear tape at nominal cost. While we must naturally concern ourselves with the Universal machine, we would say that there has been little competitive controversy on this particular subject and many box makers are doing the job satisfactorily on different makes of machines.

The original semiautomatic taping machine is designed to handle gummed tape, usually ranging in width from 1 to 3 in., and more specifically in actual widths of 2, $2^1/_2$, and 3 in. The tear strip runs $^1/_4$ in. wide, or perhaps $^3/_{16}$ in. wide. It is, therefore, of prime importance to modify the tape guiding means so that it may control a strip this narrow. Little or no change is required in the actual tape reel holding mechanism since the manufacturers of the gumed tape have been supplying it in reels having over-all dimensions substantially the same as regular rolls of wider gummed tape with corresponding dimensions for the center hole.

On the Universal taping machine, a removable block is placed on the main tape feeding and guiding mechanism. This block has a groove $^1/_4$ in. wide, and when the block is placed on the tape feeding plate, it serves to form the narrow chamber through which the tape may be guided.

In order to fashion the hand grip, which will ultimately enable the carton user to pull the tape and rip open the top of the carton, the tape must be applied on the blank at least 4-in. ahead of one end. This can be accomplished with particular ease on any electrically operated semiautomatic taping machine. As is well known, the basic operation on such a machine involves feeding of the tape as the box strikes the first actuating switch, followed by a stoppage of the feed and the cutting off of the tape when the box hits the second switch. Normally, the first actuating switch is so placed that the tape meets the box at the flap crease. In the case of the tear tape, however, the feeding switch is advanced so that the tape starts to feed somewhat ahead of the box, and the two do not meet until the 4 additional in. of tape have been fed. The box then continues, striking the second

switch at a point which will cut off the tape at the back edge of the blank. The leading 4 in. of tape has to be bent over the edge of the blank and sealed firmly so that it will be on the outside of the finished carton. On some machines, this is accomplished by feeding tape vertically downward while the blank moves horizontally. On the Universal taping machine, the fold-over is accomplished by feeding tape in the normal horizontal manner and flipping it over at the end of the belt conveyor. There are two rollers at this point, one of which folds the tape, while the other rubs it down.

When tear tape is applied on a semiautomatic machine, the operation is performed between the fabrication of the blank on the printer-slotter and the formation of the manufacturer's joint on the taper, gluer, or stitcher. Blanks as received from the printer-slotter in a flat condition are placed on the elevator of the taping machine. In the case of extremely long blanks, it might very well be necessary to place some supporting extensions on the elevator roller table. This would not be required with an average blank of, say, 65 in. But, in the case of extremely large boxes over 100 in., some support would probably be required.

The blanks are fed into the machine the long way which is at right angles to the direction normally used when taping or stitching. In spite of this, the feeding operation should be substantially faster than that normally found on ordinary taping operations since the operator is not required to fold the blank. The blank need merely be lifted slightly from the top of the pile, pushed forward a few inches until it is nipped by the feed rolls of the taping machine, from which point on, the work is performed automatically. It becomes obvious that such an operation can be performed with great rapidity approaching the speed of hand-fed slitter-scorers. Where a considerable volume of boxes are to be handled in this manner, it frequently justifies the speeding up of the entire machine, far beyond the maximum speed normally required for taping boxes. On the Universal taping machine, which normally runs at 130 to 150 f.p.m., the speeds have been increased about 25% to accommodate the rapid feed of boxes receiving the tear strip. Increases of 25% or more can be made if required.

For example, on a normal blank of, say, 7 ft. tear tape length, without increasing speed, the production would be about 1200 an hr., but it is quite feasible to feed this at a rate of perhaps 1500 an hr. or better, and obtain good results.

As in all projects of this kind which are increasing in popularity, but which are still not what you might call standard box plant operations, the production figures given today may prove to be very small compared with production that will be obtained later on. Where there is sufficient volume to justify the use of one taping machine all day long on tear tape, you are bound to obtain much better results than if it was merely an operation performed for an hour or two at a time and then put aside for a few days until the next order comes along.

We have been able, however, to obtain some production figures that may prove of interest. These figures are based on a 3-month operation involving a special container having a tape length of 21 in. Better than half a million boxes were "tear taped," if we may use that expression. The individual quantities of full runs varied from as low as 3000 to more than 60,000, the average being about 25,000.

The best run was a lot of 29,900 which was completed in 13.4 hr. for an average of 2230 boxes per hr. The over-all average was 1600 boxes per hr.

We believe that this is a fair figure to use in attempting to estimate production which can be obtained when applying tear tape on a semiautomatic taping machine. In this particular instance, the actual time of the machine devoted to tear tape was approximately 50% of the available productive hours. For the machine to operate 100% of the time, undoubtedly, the average would be considerably higher due to increased operator proficiency.

Of course, as the tape length increases, the production will be lower. However, a survey of numerous installations would indicate that averages of 1500 boxes per hr. are not uncommon with maximums frequently in excess of 2000 per hr.

For the purpose of the cost analysis or cost estimate, it is our opinion that the cost of applying tear tape is substantially the same as that of applying tape to the manufacturer's joint.

It would appear likely from current thinking that a number of new developments in both the application and use of tear tape will be forthcoming. In certain cases, the tape is being applied without the 4-in. overlap and the thumb hole is punched in the box to start the tape. To do this on the semiautomatic taper, it is, of course, a simple enough matter to merely reset the tape feed actuating switch to the normal zero position and, thus, eliminate the additional 4 in. of overlap.

In conclusion, we can say that tear tape application on a semiautomatic taping machine is entirely practical for the average box plant, and the cost is sufficiently reasonable to make available the benefits of tear tape to the small and medium-size box user.

Pressure-Sensitive Tear Tape Application

LEE PAUL

THE easiest, fastest, and surest way of opening a corrugated or solid fiber carton is with the "tear strip" easy opener, using "Scotch" brand filament tape no. 880 developed by the Minnesota Mining & Mfg. Co.

The idea of an easy opener carton is not new or original with Minnesota Mining & Mfg. Co. About 4 years ago, we ran into the idea of our no. 880 "Scotch" brand filament tape doing this job quite accidentally. On trying a good number of cartons, it worked so effectively we wondered why it had not been thought of long ago. On the possible danger that we might be violating the patents developed by the Wrigley Co. for opening cellophane wrapped packages such as candy, gum, and cigarettes with the red pull-tab, we made a patent investigation. To our surprise, we found that there were at least three patents that had been issued on easy opener carton ideas—the newest of which was issued in 1921. This brought us to the point of finding out if there was really a desire for this feature. To determine this in one particular field, our people went into several supermarkets in the Twin City area and unpacked cases of merchandise and installed the "tear strip" easy opener feature and repacked the merchandise. In every case when these cases were opened, the idea was received enthusiastically. We then contacted food product manufacturers and box manufacturers to determine their interest. Here, too, we found interest, but the subject of cost reared its ugly head. Based on slow application methods and high tape price, it looked as if this feature was going to cost 4 to 5¢ per carton. No one could absorb this cost. Our engineering departments then got busy designing high-speed applicating equipment and our production departments finding more efficient methods of producing these narrow width tapes. The result is that today on all but the largest cartons, the cost of the "tear strip" easy opener is now under $1^1/_2$¢ per carton.

To determine what the real advantage to an easy opener carton would be, we first chose the food industries to make a time-study evaluation, and found that we could save an average of 34.5% of all time required to open price-marked, shelf-stock, or mass display food products. To make this time study, we used canned goods, cereals, paper products, and packaged food items in good quantities. We found in every case where we made this time study, that the savings were sufficient to

LEE PAUL, Special Representative, Industrial Trades Tape Div., Minnesota Mining & Manufacturing Co., Minneapolis, Minn.

warrant the 1 to 1 1/2¢ cost of the "tear strip" easy opener feature and still leave some extra profit for the operator.

Such people as General Mills, Wrigley Gum, Moore Business Forms, Dow Chemical Co., many of the breweries, cheese manufacturers, furniture manufacturers, and appliance manufacturers, as well as many others, have adopted "tear strip" to eliminate damage and facilitate opening, price marking, displaying, or shelf-stocking of their merchandise.

As we gained more experience in the application of our no. 880 "Scotch" brand filament tape for "tear strip" easy opener, we found that it was feasible to apply this material at the corrugator, thus eliminating the extra operation involved with our original equipment. In fact, it is possible and has been successfully done by several corrugated box manufacturers where they have applied no. 880 "tear strip" tape on two and three box blanks at the same time on the corrugator. With the success we have had applying "Scotch" brand filament tape at the corrugator, we have reduced the cost of equipment necessary from many thousands of dollars to a few hundred dollars; thus allowing more leeway in the ultimate cost of "tear strip." Currently we have several engineering firms interested in manufacturing the equipment necessary to apply no. 880 "tear strip" tape at your corrugator or will be happy to supply schematic drawings to your engineering department in the event you wish to design such equipment yourself. In cases where an outside tab is necessary or desirable, we have automatic equipment available to you now.

The success of the easy opener program is going to be a cooperative accomplishment. You will find Minnesota Mining & Mfg. Co. ready, willing, and anxious to take its part in this cooperative venture. We have trained men covering 48 states who can work with you or through you, as best suits your needs.

Lee Paul, Minnesota Mining & Mfg. Co.

Walter Friedman, Genera Gummed Products, Inc.

The Properties, Problems, and Performance of Gummed Tear Tape

WALTER FRIEDMAN

THE subject before discussion is one where no one single person in the corrugated box and gummed tape industry is as yet an expert nor will be able to obtain substantiated knowledge and extensive experience in the very near future. The use of tear strip tapes is so new and the variables of the manufacture of easy opening boxes as well as their use are so great that some time lapse must occur before we will obtain a proper perspective on this subject. Furthermore, the introduction of tear strip tapes has created so much interest that a great deal of research is presently going on in the packaging laboratories of a number of tape and box manufacturers. This research may change the status of the field of tear tape opening devices overnight.

With this in mind I would like to state that much of the factual material which I am presenting in this paper is based strictly on our own experience in the research and manufacture of gummed tear strip tapes and our work with a number of corrugated box manufacturers who are using these products.

The gummed industry is not entirely a newcomer to the field of easy opening devices. Basically our principal concern is to provide good and economical closures for the box industry. However, for many years we have been aware of the need of providing a better method of opening boxes for the final use of the products that are being shipped. As long as gummed tape was used extensively on most packages the problem of opening a box was not a severe one and for that matter still is not today. However, due to the large increase in the use of adhesives and staples on many mass-produced items which reach the stores and consumers alike a better method became apparent.

Although it is not my intention to sidetrack from the basic topic which is before us today, I merely wish to pass over some of the opening devices in which the gummed tape industry is playing a part and others which are either presently being used or are still in an experimental stage. There may be additional opening devices which will not be covered here.

Some of these are as follows:

1. Zipper sealing tapes whereby a string or other tearing medium tears through the sealing tape and permits opening of the box.
2. Two machine glazed papers spot glued together and attached to the inside of the carton flaps. This method is commonly referred to as the "Tilly method of opening boxes" and as you may know is fully approved by the Uniform and Consolidated Classification Committees.
3. Spot gluing or spot printing on the container flaps in conjunction with regular case sealing equipment.

The preceding methods attempt to incorporate into the closure the easy opening device. With this method, or for that matter any other opening method, it is of utmost importance that the closure or the structure of the container is not weakened in any way so as to increase the possibilities for loss and damage.

It is not my intention to digress in this paper in order to discuss the many advantages of the tear strip method over other easy opening devices as they accrue to the final user of corrugated boxes. On the other hand, I would like to mention just a few of the reasons why such great interest has been shown by so many people in this particular device.

Some of these main advantages are as follows:

1. Familiarity with a tear strip tape through its continued use on such consumer packages as cigarettes, gum, etc.
2. Elimination of any tools such as knives in opening a shipping container and injury that may result from their use.
3. Elimination of cutting damage to inner packages particularly chipboard folding boxes and paper bags that may result from the use of the aforementioned knives or other tools.
4. Turning carton into a display case for individual display requirements of the contents.
5. Ease and labor saving of opening cartons, marking and shelving inner containers.

These then are some of the advantages which a tear strip tape creates on corrugated boxes. In order to fully utilize these important labor saving and convenient features it is to the interest of both the box and gummed tape industry to provide for the most economical introduction of such a device.

PHYSICAL CHARACTERISTICS OF GUMMED TEAR STRIP TAPES

"WOLCO" Rip-A-Tape, the name that we have given our gummed tear strip tape and other similar tape products

WALTER FRIEDMAN, Manager, Sales Engineering, General Gummed Products, Inc., Richmond Hills, N. Y.

is basically reinforced tape. Reinforced tapes are now being used for many packaging and nonpackaging products and can be manufactured in practically any type and any strength. For use as a box tape, the corrugated box industry has seen many such tapes reinforced with sisal, glass, and rayon in various patterns and with various tensile requirements depending on the particular type of job the tape is to perform. Such reinforced tapes generally use a high grade animal glue adhesive which is water activated and is applied on semiautomatic and fully automatic taping equipment which is available in practically all plants. Such reinforced gummed tapes are very economical and can inexpensively be applied on taping equipment.

Tear strip tapes are specifically designed reinforced tapes to provide the ripping action through corrugated board. Basically, there are two types of such gummed tear strip tapes on the market depending on their final use:

1. A tape that is designed for application with a tab as is found on cigarette packs to get a start in tearing the box open.
2. A tape designed for application with some die-cut starting arrangement incorporated in one side of the box near the manufacturer's joint.

The "tab" tape as we may term it for discussion here is the type that has so far been used by most manufacturers who have gone into production of easy opening boxes. The tab itself is generally about 4 in. in length in order to secure a sufficient firm grip on the tape when it is peeled off the side of the box. Unlike the tear tape on cellophane-wrapped packages such as the cigarette pack, the tear tape is pulled back around the box after it has been lifted from the container. The reasons for this difference will become more apparent from the discussion on applying tear tape on the semiautomatic taping machine. While on this subject it may be pointed out that a number of initial failures with a tear tape product were caused by attempting to rip the box open in the same direction as the tape is lifted off. Therefore it is of utmost importance that proper opening instructions are printed on any tear tape box.

"Tab" tear tapes are presently manufactured with either glass or rayon reinforcement. As yet, we have not been able to determine whether the greater elongation that is obtainable with rayon helps to overcome a possible failure in getting a start on the tab. Rayon reinforced tapes generally have a tensile strength of about 180 to 200 lb. per in. of width or a tensile of between 45 to 50 lb. per $^1/_4$ in. wide tape. The elongation is approximately 12 to 16%. Glass, on the other hand, for tear tape purposes has a tensile of 500 to 600 lb. per in. of width with an elongation of approximately 3%. The $^1/_4$ in. wide tear tape with glass reinforcement therefore has an approximate strength of from 125 to 140 lb. per $^1/_4$ in. We carry both glass and rayon reinforcement tapes in stock but as previously mentioned, we have as yet been unable to determine which of them are preferred for this particular use. It is, of course, possible to provide any strength and elongation requirement in a tear strip tape. However, economical factors enter the picture which rule out the majority of possibilities.

The width of tape which is presently being used on gummed tear strip tape is $^1/_4$ in. although recently $^3/_{16}$ in. has been experimented with and all indications are that this width has sufficient adhesive power as well as adequate strength with glass reinforcement having a tensile of from 500 to 600 lb. per in. of width.

The second class of tear tapes that are made may for this discussion be called "die-cut" tapes as they are used in conjunction with a die-cut pull-tab arrangement. These tapes are applied in a continuous operation on the combiner just prior to the cut-off and no tape can be overfed in order to form a tab. Further mention of the actual application will be made later in this paper. The blank is formed in the same manner as a regular corrugated box without requiring a separate operation for the tear tape application. The "die-cut" tab arrangement such as the sunburst opening is put on at the printer-slotter cutting through the tape. The box is opened by pulling on this corrugated tab and ripping around the box.

Due to the elimination of the tab, the strength requirements of the tear tape can materially be reduced. It can readily be recognized that the greatest effort in ripping the box open with the "tab" is in the initial fracturing of the board at the manufacturer's joint. Once the corrugated board has been fractured little strength is required to rip the box around its periphery as the ribbon of corrugated board has considerable strength in itself. The "die-cut" tape provides a guide in ripping the box parallel to the top and bottom and prevents the ribbon from fracturing particularly at the vertical score lines at the corners of the box. For this reason, a tape of this kind can be manufactured far less expensive and its strength requirements are in the neighborhood of approximately 200 lb. per in. of width or 50 lb. for a $^1/_4$-in. wide tear tape. A tape which has less strength than this may perform adequately on the box but it becomes uneconomical to spool such a product and breaks in applying it on the combiner would occur so frequently that its application would be extremely uneconomical. Therefore we have developed a tear tape which has just sufficient strength to be spooled and applied without any danger of breaks.

Tear tapes are furnished to the box manufacturer on spools which are suitable for the particular equipment that is being used. For the "tab" tape generally a 3-in. wide spool is being used which may range from 12 to 20 in. in diameter depending on the particular manufacturer of this tape. This size together with a $1^3/_8$-in. core fits on practically all existing semiautomatic tapers. The footage per spool is anywhere from 6000 to 12,000 ft. It might be interesting to know that spooling of a gummed tape product presented a considerable problem to the tape manufacturers who until this time were straight winding all their various tape products. This has now been overcome and the only limitation in the spool size is the particular equipment that is in use for this purpose. For the "die-cut" tape the spools have been made 6 in. wide with a 12 in. diameter containing approximately 18,000 lineal ft. This is sufficient for approximately an hour's work on the combiner. Larger spools could theoretically be manufactured but they would become extremely heavy and cumbersome to handle.

APPLICATION OF GUMMED TEAR STRIP TAPE

We do not intend to get into this subject to any great detail as it is a topic of another speaker at this meeting. However, we merely wish to state that all principal semiautomatic taping machines can inexpensively be converted for the application of a $^1/_4$ or $^3/_{16}$-in. wide tear strip "tab" tape. Unlike the taping operation for the manufactured joint, the blank is fed unfolded in a lengthwise direction through the taper with the outside or printed face downward.

The tear tape is prefed to allow for the 4-in. tab which is formed on the underside or outside of the blank. In order to perform these operations very simple changes can be made on the General, S. & S., and Universal semiautomatic tapers. In principle these involve the following operations:

1. Prefeeding of the tape through an extension of the first microswitch lever.
2. Forming the tab either immediately after the tape is prefed by deflecting it on a plate, or at the end of the conveyor through a swivel roller arrangement. On the General machine which uses rubber rollers this operation requires no change. On the S. & S. machine the belt conveyor which is being used must be deflected to allow for the extra length of tape. On the Universal machine the extra length of tape travels to the end of the conveyor and is placed around the other side of the box by a rubber roller arrangement which is mounted at the end of the conveyor.
3. Additional guides and different water application rollers to avoid twisting of the narrow tape are required.

On the combiner the application of a "die-cut" tape is far simpler since first of all no tab is required and secondly it is a continuous operation. However, at the present time no manufacturer has gone into production of equipment for this purpose and it has to be custom built for each box company. Principally this equipment consists of an unwind stand suitable for several spools of tear tape depending on the width of the combiner and the number of boxes fabricated at one time. In addition a water applicator for each tape must be provided as well as a suitable pressure roller.

The dies for the tab are stock items with one or two manufacturers and do not involve any problem whatsoever with a proper lineup of the die cut in line with the tear tape.

PRODUCTION AND PERFORMANCE PROBLEMS

With the "tab" tape initially some production problems were encountered on the semiautomatic taping equipment. These, however, have been resolved either by the manufacturers of this equipment or by a good mechanic on the job. Basically they consisted of prefeeding an insufficient length or a varying length of tape required for the tab, folding the tab over crookedly and leaving a slight loop at the end of the blank where the tab is being formed. The latter appears to contribute to building up the corrugated board rather than ripping through it when the tab is being pulled. Also, some problems in properly feeding the tape were initially found but have since been eliminated.

In the application of the "die-cut" tape insufficient experience has been obtained by us to bring out any particular problems that may be encountered with this method.

As with any new product there have been some tape failures initially in the opening of the box. However, these have been eliminated by better and stronger tapes and more care in the application of them. Furthermore, it is generally recognized that with the "tab" tape the maximum board strength that can successfully be ripped through is 200-lb. test. Above that, trouble will occur unless some assistance with two small cuts at the joint is given in getting a start on the board. With the "die-cut" tape 275-lb. test board can be ripped very easily.

It has also been pointed out to us that frequently the box is not ripped open very cleanly and that the outer liner is being defaced very severely. We have found that this problem exists with long fibered kraft but is not encountered with jute. The latter will give a very clean cut. However, as only the outer face is affected and quite frequently not too severely, to our knowledge no major objections have been raised to this defacing.

ECONOMIC CONSIDERATIONS

It is naturally impossible for me to discuss costs other than the cost of the tape of easy opening boxes with a gummed tear strip tape. The cost figures that we have obtained from people that have either used our "WOLCO" Rip-A-Tape or have made cost estimates have varied so widely that it is impossible to draw any definite conclusions at this time. Naturally with the "tab" tape requiring a separate taping operation an added cost in addition to the lineal footage cost of the tape will be required. Just how great this added application cost will be depends on many factors. Among these are the size of the blanks, speed of conveyor at which the blank travels, speed of manually feeding the blank, and the cost to handle the blanks to and from the taping machines.

The application on the combiner is, of course, not a separate one and therefore does not involve any extra costs except the setup of the spools and the supervision of properly applying the tape. The lower cost of such a tape together with its automatic application naturally makes this method of opening far more attractive than the "tab" tape.

CONCLUSIONS

In concluding, I would like to state that all of us are probably in agreement on these two important premises.

1. The tear tape easy opening device is probably the best solution to date of any method of opening corrugated boxes.
2. The coordinated effort by the corrugated box industry and the tape industry will be required to provide economies in the manufacture of easy opening boxes in order to make it practical for a large proportion of corrugated boxes that are being made.

The interest which has been created by many large users, both as shippers as well as receivers, of corrugated boxes in tear strip opening boxes has given both the box manufacturers as well as the gummed tape industry the stimulant to search for better and more economical methods. The application of tear tape on the combiner may provide the economies that we have been after since the introduction of this idea. In the meantime a concerted effort to educate the receivers of corrugated boxes to the many advantages to them of easy opening boxes should be made. It can readily be recognized that a supermarket which only receives a small portion of such boxes will not benefit greatly by this method. Therefore as the percentage of containers which can be opened in the manner previously described increases, so will the benefits in handling, marking, and shelving increase as well.

Until the detailed production methods and strength requirements of gummed tear strip tapes have been completely worked out, the semiautomatic taping machine utilizing the "tab" tape is providing the box manufacturer with a means of supplying industry with this easy opening box. Gummed tear strip tape and this machine have therefore placed the box manufacturer in a position to cater to his customers who are desirous of obtaining such an easy opening box with hardly any initial equipment investment.

The gummed tear strip tape has therefore been exceedingly helpful in making a broad section of the shipping public familiar with the easy opening box. Furthermore, since a water-soluble adhesive is still the lowest cost adhesive for any tape, it is most likely to be used on any tape product that will be incorporated in any easy opening device. Therefore, if and when the tear strip tape box will become accepted on a much broader scale than it is now, undoubtedly, gummed tear strip tapes will be used very extensively and the gummed tape industry is fully equipped to take care of these tape requirements.

Q.: On the average, how much makeready time is required to change a semiautomatic taper from 21-1 in. conventional taping to $^1/_4$-in. tear strip tape?

Mr. Lowery: Two to three minutes over standard makeready time provided that only the guide block has been removed.

Q.: How is the tape kept from buckling?

Mr. Lowery: Because tear strip tape is spool wound, it has a natural curl which at times is sufficient to cause the tear strip tape to buckle or, in some cases, turn over completely at the start of the tape feed operation. A weight near the nip of the pickup rolls will prevent this condition.

Q.: How is the tape kept from turning over?

Mr. Lowery: (1) By having proper alignment (guides must be perpendicular to the center line of the pickup rolls) or (2) a weight near the nip of the pickup rolls.

Q.: How is the tape kept running straight?

Mr. Lowery: Surface speeds must be kept in proper relationship. Also be sure guides are perpendicular to the center line of the pickup rolls.

Q.: (1) What is the highest bursting strength test grade of box, both corrugated and fiber, on which 3M no. 880 tape has been used successfully for easy opening? (2) What was the width of tape in those applications?

Mr. Paul: (1) It has been used successfully on the Wrigley box which carries a 400-lb. certificate but which tests out between 400 and 500 lb. (2) Our $^3/_{16}$-in. tape is recommended for board up to 200-lb. test but can be successfully used on certain types board in excess of 200-lb. test. One-fourth-inch tape is recommended for board testing over 200 lb. and is the width now being used on the Wrigley container.

Q.: What are the relative costs per 1000 boxes of tear tape on the Webber machine and tear tape on the corrugator?

Mr. Paul: Webber—$3.00 to $6.00 per 1000. Corrugator—based on one cost study on a large container we found the following: $1.75 per 1000 (warped stock); $0.87 per 1000 (unwarped stock).

Q.: What is the length of your "Scotch" brand no. 880 tape in 3/16 in. width?

Mr. Paul: 18,000 ft.

Q.: Has any difficulty been encountered with tapes scuffing off at the printer-slotter after the tape is applied at the corrugator?

Mr. Paul: There were some initial problems. Since the board is hot at the point of application, it is important that the pressure roller be properly adjusted, and we have found that this will eliminate any problem.

Q.: Has your company tested rayon versus glass fiber as pertains to opening failure?

Mr. Paul: We know that glass fiber reinforced tape has more tensile but it lacks the elongation property which we consider essential. Where the tape is creased at the score lines during storage and shipping we find that the glass filaments crack, causing failures in the opening.

Q.: (1) Will tear tape tear satisfactorily with the corrugations? (2) Is a "die-cut tab" necessary when 3M tape is applied at the corrugator?

Mr. Paul: (1) Yes, but it will tear more of the outer liner. (2) A die cut or slot is required.

Q.: Do you have an attachment for the application of tape on the corrugator that applies the tape with the extended piece folded back on the sheet? If so, do you have pictures or prints?

Mr. Paul: No. No tab is used when tape is applied at the corrugator.

Q.: Where can I get a complete description of the Webber machine? Can this machine be used by all corrugated carton manufacturers or is it used only by specialists?

Mr. Paul: Minnesota Mining will be glad to demonstrate it and explain all details of its use. Any machine operator can operate this equipment after a very brief instruction period.

Q.: Is tear tape ever used on double-wall board?

Mr. Paul: We know of no users at present, but our tests indicate that it can be successfully done.

Q.: What per cent of tear strips fail on opening?

Mr. Paul: If properly applied, "Scotch" brand no. 880 tear strip tape will never fail.

Q.: Where tear strips have been adopted is information available or a survey made as to the extent retail handlers are utilizing it to open cases?

Mr. Paul: We have a sales force of 750 people covering every state. A canvass is made to be sure the retailers know how to handle it. A recent survey made at the request of the Wrigley Co. indicated by far the majority of people were utilizing it and enjoying the enormous time savings, as well as eliminating damage to the product.

Q.: How do you prevent fracturing the glass tape during the scoring operation? We would like to hear specifically if you have encountered trouble.

Mr. Paul: We do not recommend the use of a glass reinforced tape at this time, and the only difficulties we know that have been encountered pertain to the failure in opening by the users. We have eliminated difficulties by our laboratory tests indicating that our no. 880 rayon reinforced "Scotch" brand tape was superior to similar material with glass reinforcements.

Q.: How did you measure the tensile strength needed for "die-cut tear tape"—by trial and error, designing new testing equipment, etc.?

Mr. Paul: We have a complete tape laboratory in St. Paul. All tapes are laboratory and field evaluated: 3/16 in. is OK for 200-lb. test board; for over 200-lb. test, check it first, or use 1/4-in. tape to be certain.

Q.: What is the cost of a pressure-sensitive tape per foot?

Mr. Paul: The cost for 3/16-in. pressure-sensitive—0.2¢ per lineal ft.

Q.: How much cracking of the glass fiber-type tape occurs when it is bent upon itself?

Mr. Friedman: Very slight. There is some loss in tensile strength at the vertical score lines when the blank is scored at the printer-slotter. However, since the tape is overdesigned in strength the slight reduction in the tensile strength does not affect the ripping qualities of the tape.

Q.: What minimum tensile strength is necessary for a successful tear tape on: (1) 200-lb. test box, (2) 275-lb. test box, and (3) 350-lb. test box?

Mr. Friedman: For the tab tape opening either the glass reinforced tape (tensile 600 lb. per in.) or rayon reinforced tape (tensile 180 lb. per in.) are adequate through the 275 lb. range. (Either 1/4 or 3/16 in.). For the die-cut tape opening, glass tear tape is good through the entire bursting strength range.

Q.: In the case of die-cut tape, what type of die cut has proved most satisfactory: (1) notches at edge of blank or (2) finger hold die-cut?

Mr. Friedman: No preference. TAPPI or the Fibre Box Association should standardize on the best procedure.

Q.: What do you believe will be the ultimate low cost of tear tape per 1000 yd.?

Mr. Friedman: It depends on developments. I would say one half of the present cost of $3.50 per 1000 yd. in 1/4 in.

Q.: Have any reports been received from the packagers on problems resulting from tear tapes being ripped or pulled loose on loading lines?

Mr. Friedman: No. If the tape is properly moistened and applied, this should be no problem. Sharp items might be an exception.

Q.: What problems, if any, might be anticipated with tear tape interfering with the automatic filling of the container when the pack is very tight?

Mr. Friedman: A tear strip tape with a water-soluble adhesive becomes an integral part of the container when the tape is properly moistened and applied. Therefore, even if the pack is very tight, no difficulty should be expected on automatic filling machines.

Q.: What is the estimated cost per lineal foot of your newly developed 3/16-in. glass reinforced tape?

Mr. Friedman: 1/4-in. glass reinforced is $3.50 per 1000 yd. 3/16-in. should be somewhat lower, but we do not have adequate costs at present.

Q.: (1) How does tear strip affect strength of the container? (2) Has the "Freight Classification Committee" approved the tab type or die-cut type openings?

Mr. Friedman: (1) The vertical score lines of a container are slightly reinforced by the great strength of the tear tape. This, however, is insignificant for the over-all performance of the container. Naturally no weakening effect whatsoever is being introduced by the tear strip application. (2) Approval is not required for the tab since the carton is not altered in any way. The die-cut tab is covered in Rule 41, Section 2, which deals with hand holds.

Q.: In view of the obvious economy of the die-cut tape method, why mess with the tear tab at all? Does the tear tab have any advantage over the die-cut tape?

Mr. Friedman: The tab tape has found initially great acceptance with the shipping public since its appearance and operation are almost like that of cigarette packs and similar consumer packages. Furthermore, existing equipment can so easily be converted that practically any box manufacturer is able to manufacture boxes of this type with a gummed tear strip tape. As with any evolutionary process the "die-cut" tape came into the picture later and undoubtedly will be used almost exclusively in the future. This, however, will take some time as standard equipment must first be developed or each individual company must be willing to fabricate its own. As to the ripping quality, no advantage of one or the other has, as yet, been determined.

Q.: Is any attempt being made by the industry to standardize on a tear strip finger hole? If not, wouldn't it be desirable to do so?

Mr. Friedman: We do not know. It would be very desirable and should be done by some organization such as TAPPI or the Fibre Box Association.

Q.: What, if any, problems are encountered in feeding blanks taped on the corrugator through the printer-slotter due to the added thickness of tape?

Mr. Friedman: We cannot answer this as the question has never been raised before. If it is a problem, we would like additional information.

Q.: Can tear strip be applied to horizontal as well as vertical corrugations?

Mr. Friedman: It can be done on the semiautomatic machine subject to the limitations of that machine as to the width of the blank that can be passed through. It cannot be done on the corrugator.

Q.: Please explain the steps in applying and die cutting. Which comes first—die-cutting or tape application?

Mr. Friedman: Tape is first applied (at the corrugator). Die cut on the printer-slotter. The die cut must be properly positioned so it cuts the entire width of the tape.

Q.: Why not apply gummed tape without moistening at the single-facer pressure drum? Will not the steam and moisture being released here make a strong enough bond?

Mr. Friedman: I don't know. It's something to work on.

High Humidity Containers

J. J. Koenig of the Gaylord Container Corp. was the chairman of the session held Tuesday afternoon, Feb. 16, that was devoted to high humidity containers. Following the presentation of the papers there was a panel discussion led by D. C. Shepard, Jr., of the Menasha Woodenware Corp., Menasha, Wis.

Reinforced Corrugating Media in High Humidity Containers

H. S. GARDNER, G. E. MARTIN, O. P. WANAMAKER, and D. E. KANE

Fibreboard Products, Inc. has been using sulphur impregnated corrugating media for about 3 years. During this time the Research and Development Div., in cooperation with the mills, has been studying the product in an effort to define clearly any advantages which are gained by such a process. These evaluations have been carried out, whenever possible, by comparing containers which were identical, insofar as the manufacturing operations can be controlled, except for the addition of sulphur to one or more of the container lots. From these studies, and from reports of field performance, the conclusion has been reached that the sulphur impregnation of corrugating medium contributes substantially to the strength of the finished container.

The impregnation process, developed at The Institute of Paper Chemistry (*1*, *2*) is essentially a roll coating process with sufficient pressure being applied at the nip to drive the molten sulphur into the sheet. The accompanying illustrations show various views of the impregnator. Normally the sulphur is applied to one side of the sheet only, but is driven into the board, at the nip, to the extent that fibers are exposed on the impregnated side. This is necessary in order to leave a surface which is compatible with the aqueous corrugating adhesive. The amount of sulphur taken up by the board depends upon the characteristics of the sheet as well as upon operating variables; however, sulphur is normally added to the extent of about 45% of the weight of the fiber. The basic corrugating medium is a 32-lb. kraft semichemical board.

The ultimate quality of the combined board depends, not only upon the amount of sulphur added, but upon the original properties of the board and the numerous impregnation and corrugating variables such as board moisture content, temperature, and machine speed. For the most part, the satisfactory combination of operating conditions has been found by operating experience. However, one of the more determinative board properties, the freeness of the board stock, was recognized in early experience and has been, at least, partially investigated at the San Joaquin Division of Fibreboard Products, Inc. under the direction of R. W. K. Ulm.

If the board is run at a comparatively high freeness, it might pick up as much as 70% of its weight of sulphur in the impregnation operation. This pickup could be reduced to below 40% for the same stock if the sheet were formed at a somewhat lower freeness. This dependence of sulphur pickup on freeness for one particular run of board is shown in Fig. 1. In the range of freenesses investigated, about 350 to 600 ml. Canadian Standard, the sulphur pickup varied almost linearly with the freeness. A similar trend has been apparent in other experiments; however, the linearity of the relationship is not always present.

Of more immediate significance than the amount of sulphur picked up by the corrugating medium is the contribution of this sulphur to the ultimate compressive strength of a container. Recent tests indicate that when the amount of sulphur picked up is governed by the freeness of the medium, the contribution of the sulphur to the container top-to-bottom compressive strength increases with the amount of sulphur added. Data are too limited, however, to define the exact nature of the relationship. To offset this trend, freeness changes appear to affect the intrinsic strength of the corrugating medium to a greater degree than they affect the secondary strength change due to the variation in sulphur pickup.

H. S. Gardner, G. E. Martin, O. P. Wanamaker, and D. E. Kane, Research and Development Div., Fibreboard Products, Inc., Antioch, Calif.

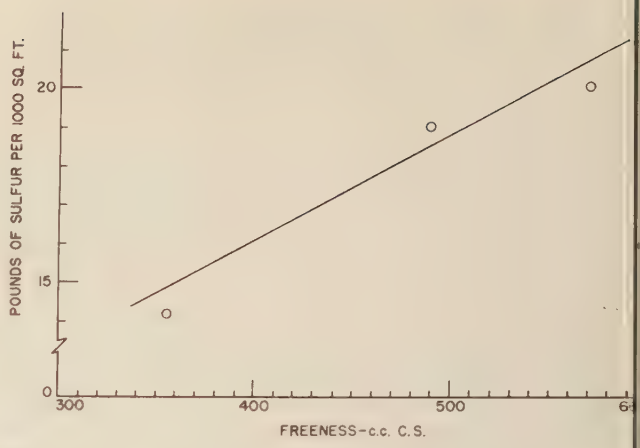


Fig. 1. Variation of sulphur pick-up with freeness of stock for corrugating medium

This relationship is shown in Fig. 2, in which container compressive strength is plotted as a function of the freeness at which the corrugating medium was manufactured. The lower curve illustrates how the compressive strength of a particular container might normally vary with the freeness of the corrugating medium. The upper curve shows what might be expected if similar containers using sulphurized medium were tested. The strength gained by additional refining of the corrugating medium appears to outweigh the loss in strength due to the reduced sulphur pickup at the resulting lower freeness. The relationship has not been studied at freenesses below 350 ml., however, there are indications that the strength of the sulphur impregnated board levels out or even decreases, at lower freeness levels.

Figure 2 gives some idea of the top-to-bottom compressive strength increases to be obtained from the use of sulphurization. The data for these curves were obtained from containers manufactured under carefully controlled conditions. The strength gained in normal manufacturing operations usually varies considerably. These variations are very possibly affected by the type of flute used and the size and shape of the container. However, the precision of the test results and the limited number of container types which have been tested do not permit the isolation of such influences. Speaking in general terms for all containers, an average increase of about 25% in top-to-bottom compressive strength normally results from sulphurization. The per cent of compressive strength lost in high humidity storage is about the same for the sulphur impregnated board as for the plain board.

The flat crush of sulphur impregnated board is substantially higher than that of plain board. The average increase ha

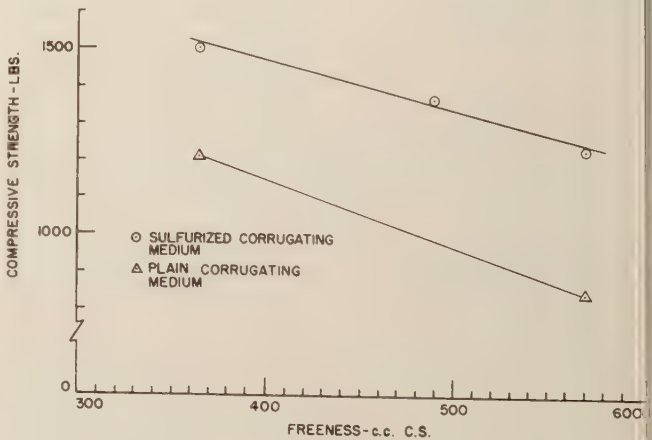
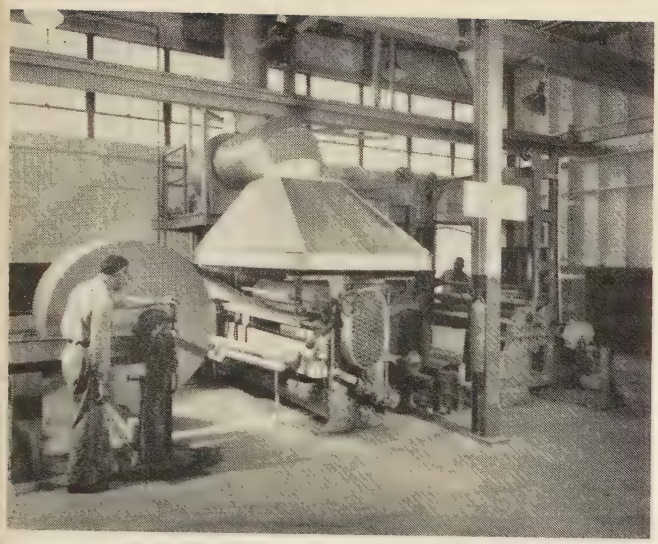


Fig. 2. Variation of container top-to-bottom compressive strength with freeness of stock for corrugating medium

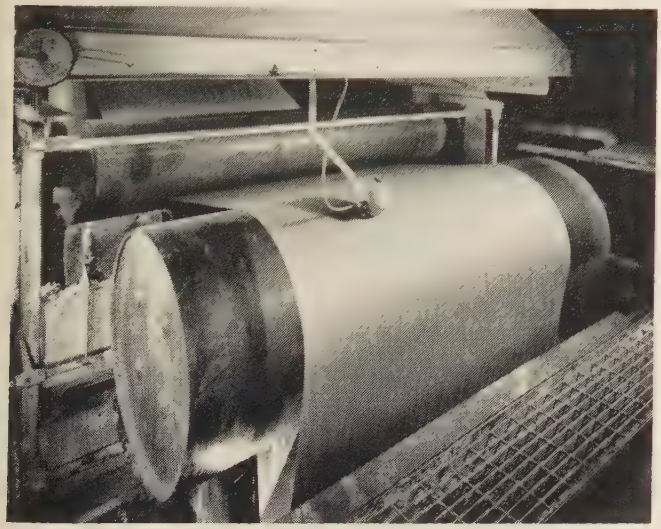


General view of sulphur impregnator showing operation at start-up

been found to be about 50%. This increase in crush resistance probably plays an important, although secondary, part in the greater top-to-bottom compressive strength of containers using sulphurized board. A large number of containers carry heavy printing patterns requiring high printing pressures on the printer-slotter. A board with high crush resistance will sustain less damage in this operation and therefore retain a higher proportion of its original compressive strength than one with low crush resistance. Thus sulphur impregnated board has, in addition to its greater initial strength, the ability to resist damage in manufacturing operations which would normally cause strength loss. Any strength improvement due to increased crush resistance is, of course, included in the 25% increase in compressive strength which was mentioned earlier.

Ring stiffness tests on sulphur impregnated and plain corrugating media show that a large increase is brought about by impregnation. However, possibly because of subsequent changes to the structure caused by the corrugating operation, these ring stiffness values appear to have less significance than is normally the case.

The moisture vapor pickup of the two types of board is essentially the same if the dry weight of the sulphurized board is corrected for the sulphur present. The sulphur does act as a sizing agent, to some extent, and sulphur impregnated board resists liquid water more effectively than does plain board. This factor appears to be of importance in containers which are stored in refrigerated warehouses and then stacked in warm humid atmospheres. Under such conditions liquid water condenses very rapidly on the container surfaces and the total moisture content, including some liquid water within the container walls, will sometimes rise above 30%. Sulphurized board appears to pick up about 10% less water than plain board when conditioned in such a manner.



Path of corrugating medium through coating nip and around reheating drum of sulphur impregnator

Stacking tests, which involve this condensation shock, demonstrate a clear-cut advantage to the use of sulphur impregnated corrugating medium. A test of this type has been run on citrus containers which utilized a case and collar construction. Collars are corrugated boards which fit around the inside perimeter of the case and extend the full depth of the case. The containers using plain media throughout failed in about 2 to 3 days under the stacking conditions used. The containers with the sulphurized medium in the case and collar were still standing at the end of 7 days under the same stacking conditions. This superiority of sulphurized board over plain board has been demonstrated even more widely by field performance and consumer preference.

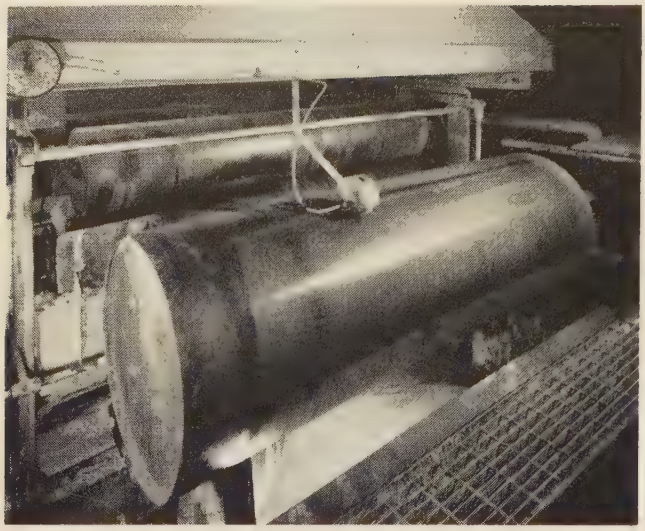
There are, of course, disadvantages to the use of sulphur impregnated board. One of the more serious of these is the broke problem. The presence of sulphur in the medium prevents its repulping for use as corrugating medium. At the corrugator, adhesion of the impregnated side of the medium to the liner is a critical point of the operations. Through operating experience, the respective properties of the medium and water-resistant adhesive have been adjusted to allow time for sufficient penetration of the adhesive into the medium. Moreover, once this bond is formed it appears to be slightly more water resistant than is the case with plain corrugating medium.

A second method for reinforcing corrugated board for improved high humidity performance is found in the use of laminated corrugating medium. Fibreboard Products, Inc. does not produce this type of board and our experience with it has been quite limited. No information with respect to the problems accompanying its manufacturer is available and only generalities can be presented with respect to its performance.

Laminated corrugating medium does produce a board with very high flat crush, in some cases to the point where printer-slotter damage would, very probably, be virtually eliminated. In most of our contact with this type of board, however, its use has been restricted to collars. Since collars are not normally subjected to the printer-slotter operation, the exceptional crush resistance afforded by laminated medium may not be needed here. Actual flat crush values obtained with this board vary over wide ranges; the boards we have examined have generally had flat crush strengths on the order of one and one-half to two times that of our sulphurized board.

Two corrugated boards of about the same basis weight, one of which used a laminated medium, have been compared on the basis of the strength they contributed as collars to a given container. The difference in weight of the corrugating mediums was made up by increased liner weight in the board with the normal medium. The container with the laminated corrugating medium in the collar gave slightly greater stacking strength than the container with the regular collar. These stacking tests were made under the condensing conditions mentioned previously. The measure of stacking strength for this comparison was the amount of settling which the containers suffered under load.

The top-to-bottom compressive strength of the container with the laminated medium in the collar was substantially higher than that of the container with the regular collar. The difference amounted to about 12% of the compressive



Impregnating rolls and reheating drum of sulphur impregnator

strength of the container with the regular collar at 90% relative humidity.

One obvious disadvantage to the use of a laminated corrugating medium is the introduction of the third adhesive line in the combined board. If the container is to be used under very humid or wet conditions, the laminating adhesive must be of the same water-resistant type as the regular corrugating adhesive.

Present information is inadequate for a comparison of sulphur impregnated corrugating media with laminated corrugating media. The available data permit only a comparison of the entire container quality and it is impossible to compare directly the contributions of the respective media to this container quality. Both types of containers have seen extensive commercial usage and both have satisfactory performance records.

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Starch Adhesives in Sulphur Treated Corrugating Medium

CLAUDE H. FLETCHER

DURING the last few years, considerable time has been devoted in the laboratories and in the corrugating plant to the problem of increasing the crush resistance on corrugated board. Undoubtedly the reason for the increased amount of time spent on this problem has been the new uses for corrugated board, higher standards in customer demand, and the desire of the corrugating industry to give the best possible product to its users.

Along the line of increasing the crush test has been considerable experimenting in the technical department and work in the plant on the use of a sulphur-treated semichemical medium. The methods of application and end results may vary somewhat from section to section of this country, but the principle seems to be the same, namely to impregnate the single-factor side of the medium with melted sulphur. This is usually done on an off the corrugator operation, although some of the initial work on this was done with the melted sulphur being applied to the medium just before it went into into the single facer section of the corrugator. The sulphur is usually applied at about 180°F. and the pickup in the me dium is approximately 50% of the weight of the semichemic sheet.

It is very difficult to ascertain the exact tonnage or squa footage of sulphur-treated board being made in this countr today, or the percentages being made in the various sectio of the country. Undoubtedly, many corrugating plan experimented with this type of medium and board in th plant, later dropping it because of the difficulties encountere and the inability to rework the scrap into the system.

It must be remembered that this type board is still co sidered a new development, and there are certain procedure in the application of the sulphur, bonding of the medium an linear on the single facer, and the preparation and applicatio of the starch adhesive which cannot be published, as the have been developed, altered, and altered again in the cu tomer's plant.

With permission granted by one corrugating plant, w would like to give you three separate starch adhesive formula which have all been run successfully on their corrugator. Th plant has a 666-gal. Henry Pratt paste mixer and has a on viscosity system using the same formula for both the singl facer and double facer. The starch adhesive used has a vis cosity of 32 sec. at the single-facer paste pan at a temperatu of 100°F. The viscosity is 35 sec. at the double-facer pa at approximately 95°F. All of these viscosity tests wer taken on the Stein Hall metal viscosity cup.

The first formula, which was used in this plant about 2 yea ago, is alkaline and not weatherproof. The formula is a follows:

Upper Mixer (Francis)

1. Add water at 100°F. to 16 in. from the top of the mixer.
2. Add 175 lb. of pearl starch and mix for 5 min.
3. Add 30 lb. of caustic soda previously dissolved in 12 ga water.
4. Heat to 140°F. and continue agitating for 15 min. more.
5. Add water to 5 in. from the top of the mixer.

Lower Mixer (Day)

1. Add water at 100°F. to 20 in. from the top of the mixer.
2. Add 30 lb. of borax (10 mol.) and mix for 10 min.
3. Add 1125 lb. of pearl starch and mix for 10 min.
4. Add the starch from the upper mixer to the lower mixe very slowly. This takes 15 min.
5. Add water to 5 in. from the top of the mixer.
6. Add preservative and mix for 30 min. to correct viscosity

The second formula was used when weatherproof result were desired and is as follows:

Upper Francis Mixer

1. Add water to 14 in. from the top of the mixer at 100°F.
2. Add 175 lb. of pearl starch and mix for 5 min.
3. Add 2 lb. of caustic soda previously dissolved in 5 gal. c water and mix for 5 min.
4. Heat to 180°F. and continue mixing for 5 min. more.
5. Add water to 5 in. from the top of the mixer.

Lower Day Mixer

1. Add water to 20 in. from the top of the mixer.
2. Add 1300 lb. of pearl starch and mix for 15 min.
3. Drop upper mixer content to the lower mixer very slowly This takes 20 min.
4. Add 130 lb. of dry urea-formaldehyde resin and mix fo 15 min.
5. Add 30 lb. of aluminum sulphate very slowly and mix fo 10 min.
6. Add water to top of the lower mixer.
7. Add preservative and mix for 30 min. to correct viscosit of approximately 40 sec.

The third formula is used at present in this corrugate plant on all sulphur-treated board and this contains a ketoni resin which makes it possible to run an alkaline paste an obtain weatherproof results.

The formula is as follows:

Upper Francis Mixer

1. Add water at 100°F. to 16 in. from the top of the mixer.
2. Add 175 lb. of pearl starch and mix for 5 min.

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3. Add 25 lb. of caustic soda previously dissolved in 12 gal. of water.
4. Heat to 140°F. and continue agitating for 15 min. more.
5. Add water to 5 in. from the top of the mixer.

Lower Day Mixer

1. Add water at 100°F. to 20 in. from the top of the mixer.
2. Add 25 ml. of borax (10 mol.) and mix for 10 min.
3. Add 1125 lb. of pearl starch and mix for 10 min.
4. Add contents of upper mixer to lower mixer very slowly. This takes 20 min.
5. Add 5% on the dry weight of the total starch in the formula of a ketonic resin. This is added very slowly.
6. Continue mixing until the viscosity is correct at approximately 40 sec.

There are undoubtedly a host of different starch formulas which will and are performing satisfactorily in the corrugating plants using sulphur-treated medium. These may vary in the amount and type of starch in the carrier portion and the amount in the raw starch portion.

Perhaps it doesn't make a great deal of difference as to the exact details and steps of the formula, but rather that sufficient of the starch adhesive is applied to the medium for good bonding.

Case Sealing Adhesives for High Humidity Container Storage

W. W. SEDERLUND

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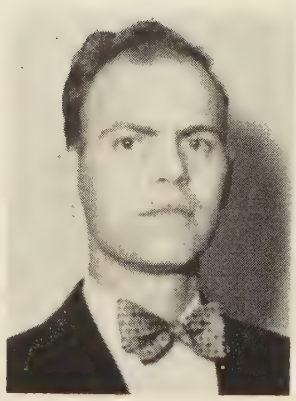

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FROM an engineering viewpoint humidity is defined as the pounds of water vapor carried by 1 lb. of dry air under any given set of conditions. Whether we speak of high relative humidity or high percentage humidity, one thing is certain—we are concerned with water in vapor form and in such quantity as to create a condition of dampness, to raise the moisture content of paper, to affect the setting and drying of adhesives, and in some instances to adversly soften and weaken dried adhesive films.

Since high humidity is a very pertinent factor in the case sealing operation, we intend to discuss the effects of high humidity during the sealing operation, as well as during storage of the sealed cases.

Any of the regular case sealing glues applied "cold" (i.e., at room temperature) depend on the loss of the vehicle (usually water) to set. By set we mean that the glue has been transformed by loss of water from a free flowing liquid to a viscous mass with sufficient resistance to slip or yielding to withstand the spring of the case flaps or stresses which tend to open the case as it comes off the machine. Further dissipation of water from the adhesive film into and through the case stock dries the film and brings it to full strength.

The setting and drying of an adhesive may be achieved by water loss due to evaporation and to absorption into the paper stock. In most case sealing operations the time during which the wet glue film is exposed to the air and evaporation occurs is very short; hence water loss by absorption is considerably more important than loss by evaporation.

The hygroscopic characteristics of cellulose and paper are well known. Paper stored under damp conditions or under normal atmospheric conditions during periods of high humidity takes up moisture. The greater the moisture content of the paper, the less is its ability to absorb water from the glue and set it quickly. Therefore, if a sealing operation is just getting by under normal humidity conditions, higher humidity may necessitate a longer compression time or a change to a higher solids, faster setting glue.

Let us assume that the case has been satisfactorily sealed and is now being either shipped or stored. What effect may high humidity have on the dried adhesive film? Assuming that a nonhygroscopic vegetable adhesive designed for case sealing has been used, our experience has been that a relative humidity of approximately 90% must be reached before one need be concerned about softening of the glue film and bond failure. Besides relative humidity, other factors such as temperature, time of exposure, and the type of case stock have an important bearing.

The adjective "hygroscopic" as used in most packaging work pertains to the ability of readily absorbing and retaining moisture, and hygroscopicity is usually expressed as weight of moisture absorbed per unit weight of sample.

For describing a property of adhesives, we do not use hygroscopic in this sense. The definition used in the field of botany has greater practical significance for the adhesive manufacturer and the user. Here the term hygroscopic indicates *sensitivity to moisture*. Since we and our customers are mainly concerned with the sticking ability of adhesives, we are far more interested in the physical strength of the adhesive film at high humidity than in the exact moisture pickup. Therefore, we simply test glue films or bonded materials for softening of the glue film and make no attempt to determine the actual moisture pickup. Since some types of adhesive bases have the ability to carry considerably more moisture without excessive softening than others, it is quite possible that a glue which we consider less hygroscopic than another on the basis of film softening might absorb more moisture at high humidity.

It has been our observation that most adhesives under humid conditions show greater hygroscopicity (i.e., sensitivity to moisture) as the temperature is increased. For example, 90% R.H. at 100°F. will soften an adhesive film more than 90% R.H. at 60°F. This greater softening may involve viscosity and solubility relationships with temperature. Higher temperature, then, in conjunction with high relative humidity, aggravates the humidity problem. With the relative humidity of 90%, we suggest a temperature of 90 to 100°F. as a critical zone for commercial vegetable case sealing glues. Raising the relative humidity and temperature—particularly the relative humidity—above these values creates a condition which approaches the performance limit of vegetable case seals and differences are apparent between various grades.

In some instances, the glue film may just soften sufficiently to yield and eventually fail on flaps that are under constant tension. Under extremely severe conditions, the glue may soften and liquefy to such an extent that it is completely absorbed by the case stock, creating a "starved" joint, i.e., an insufficient film between the flaps to stick them.

Time of exposure is a big consideration. Unless the relative humidity–temperature factor is unusually severe, prolonged exposure, i.e., 24, 48, or 72 hr. may be required to bring about failure of the bond. Many times atmospheric humdity and temperature are severe for a period of a few hours, but the

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average over a 24-hr. period is not sufficient to cause failure. The seal on a case does not react to the hourly changes in temperature and humidity. This is easily realized when you consider that the glue film is sandwiched between the case flaps. The case stock is just as thirsty as the glue and the moisture absorbed by the glue must first pass through the paper. Time is required for this transfer. The buffering action of the case stock is especially apparent on solid fiberboard. Naturally if this stock fiberboard has an asphalt barrier like some grades of V board, then the protective action is even greater.

Most case sealing glues will show better results on soft jute than on hard fibered kraft under stringent relative humidity–temperature conditions. The jute has lower tearing strength than the tough kraft so that the glue film can soften to a greater degree on jute before the glue ceases to pull fiber and failure is noticed.

The most popular and widely used class of adhesive for both machine and hand case sealing is the borated dextrin. This borated dextrin classification includes numerous products which are based on the same general type of formulation but vary among themselves in the degree of conversion of the base, the solids content, and setting speed. These adhesives are considered nonhygroscopic and any would be sufficiently humidity resistant for ordinary commercial use. Under especially stringent humidity and temperature conditions during storage of cases, differences in humidity resistance between borated dextrins will be apparent. Therefore, such a condition should be called to the attention of your adhesive supplier. Unfortunately, the borated dextrins which are made from less converted bases and are slower setting usually have better humidity resistance so that some sacrifice of setting speed may be necessary to get the desired humidity resistance. If the sealing operation is such that very fast set is also required, it may be necessary to use a resin adhesive. We shall discuss resins later.

In some large volume operations cold water solubles may be used for sealing. The fact that such products supplied in dried form are readily soluble in *liquid* water does not mean that they are poorer than liquid borated dextrins for resistance to water *vapor*. The humidity resistance of these cold water solubles is comparable to that of prepared liquid glues.

Although government specification Jan-P-120 covers folding paperboard cartons, section C-lb on adhesives is certainly of interest in our discussion of case sealing. To be sure that everyone knows the difference—a carton is the small paperboard container for cough drops, dried beans, sugar, etc. holding from a fraction of an ounce to several pounds. A case is usually larger than a carton and is the corrugated or solid fiber container with jute or kraft liners used for shipping purposes. The section on adhesives in Jan-P-120 states, "Adhesives used for making manufacturer's joints, laminations, and closures shall be sufficiently moisture-resistant so that after storage for 3 days at 90% R.H. and 100°F., the joints or closures will be strong enough to permit normal handling of the carton and contents without failure."

As previously mentioned, this humidity-temperature condition represents just about the limit of performance of the borated dextrin group and the fact that many adhesives which have been used for years for carton work and have successfully withstood all extremes in climatic conditions are not quite resistant enough to meet this specification indicates that 90% R.H. and 100°F. for 3 days is a more difficult test than ordinary shipping or storage. This test, therefore, would be unnecessarily severe for commercial work. There are some other kinds of vegetable adhesives which will meet Jan-P-120 with a comfortable margin, but these are too slow setting for high-speed case sealing lines.

Although high humidity resistance implies the ability to withstand water vapor, under some conditions in high humidity systems where sudden temperature changes are involved, a degree of moisture or water resistance may also b necessary. When the relative humidity is high, a sudden dro in temperature may cause precipitation of water. In othe words, the dew point is reached. If the amount of precip tated moisture is small, it can be absorbed by the case stoc and regular borated dextrin adhesives are not affected. Fo example, these glues are used for sealing cases of frozen foods Although the frozen food cases may be exposed to high sum mer humidities for short periods of handling during shippin and storage so that moisture is precipitated on the cas surface, the time of exposure is usually so brief that the sea is not affected. If the sweating condition is such that th case stock becomes saturated with water, it is necessary t use a water-resistant adhesive.

A good example of how serious moisture precipitation ma be is the shipment in closed freight cars of paper sacks of po tatoes. During the day with the warmth of the sun, moistur is evaporated from the potatoes. When the temperatur drops during the night, the moisture above the saturatio level is precipitated, creating the effect of a rainfall withi the car. For this reason, wet-strength kraft and water-re sistant adhesives are used in the fabrication of potato sacks

When an exceptional degree of humidity resistance is re quired or when cases will be exposed to liquid water for pro longed periods so that the case stock becomes saturated water-resistant adhesives should be used. Resin emulsion and extended resin adhesives are available for both hand an machine application. The straight resin types are suggeste where very fast setting speed is required. The less expensiv extended resins (so called because they are extended wit inert pigments, starches, etc.) may be used for the slowe machine jobs and for hand sealing. Both types show very high degree of water resistance and are used for sealin V cases under specification MIL-A-101A where a 24-hr. wate immersion test is stipulated.

We do not wish to leave the reader with the mistaken im pression that case sealing glue failure at high humidity is common problem. On the contrary, such problems come u infrequently, indicating that the regular borated dextri have more than adequate humidity resistance for most co mercial work.

We shall close with a brief mention of another proble which conceivably could arise as a consequence of high hu midity storage but rarely does. High humidity, particularly in conjunction with moderate heat, may promote bacteria action and mold growth. Adhesives, like many other ma terials, are more susceptible to bacterial action as the wate content increases. However, since the adhesives are ade quately preserved for storage in the liquid state and since even after high humidity storage for a long period the drie glue film rarely picks up enough moisture to bring it to the moisture level of the liquid state (if it did, you would have bond failure), it appears that molding of the glue film shoul not occur.

For all practical purposes, this is true; but occasionally bacteria present on case flaps as a result of storage an handling may promote molding even though the liquid glue in the drum shows no sign of mold. And sometimes mol originating in the starch sizing in the board may overcome the reluctance of an adhesive film to spoil.

Our foregoing comments and recommendations can be briefly summarized as follows. Bond failure due to excessive softening of the glue film represents the major problem o case sealing adhesives for high-humidity container storage However, an effective and practical solution to this problem exists for users who find the borated dextrins inadequate for their conditions of storage. Resin emulsion and extended resin adhesives are available from most manufacturers; and many of these products will not only withstand high humidity but also indefinite water immersion. The resins and extended resins are fast setting, machine well, and can be used

in any of the usual case sealing machines or hand sealing operations. As a matter of fact, many companies after observing the ability of these products to seal V cases with springy flaps and tough liners, have continued to use them on corrugated cases for domestic shipment to insure a more positive seal and less interruptions in production.

Laboratory Testing of Effect of High Humidity on Containers

CHARLES J. ZUSI

The subject of laboratory testing to determine the effect of high humidity on corrugated containers is an interesting one, but I will confess at the start that I tried to avoid this talk for several reasons, not the least of which is that I knew that a summary of what it would be necessary to say would state that we really do not know enough about such testing. Nevertheless, your committee was correct in picking the subject because it has become important to manufacturers of corrugated containers and to shippers in many fields. The development of high wet-strength boards and of coatings and treatments of components and fabricated sheets has raised the promise of the widespread use of corrugated boxes in markets long closed to them. Prominent among these are uses as shipping containers for fruits and vegetables and for products which are subject to cold storage. In order to carry out the development of satisfactory designs for these purposes, it is necessary to have suitable testing methods and equipment.

It has been known for a long time that moisture in the atmosphere affects the properties of fibrous materials, particularly wood and paper. Some of the references cited in a Forest Products Laboratory paper on the hygroscopicity of pulp are to tests reported as early as 1882. Some careful studies on the effect of humidity on the strength of paper and of paperboard were published in 1917 and 1918. Many other investigations have been made since then. Looking over these historic studies, perhaps one would expect that each set of experiments would add something to what had been found previously and thus the body of available data would be built up for the enlightenment of today's student. Unfortunately, this is not what the records disclose. One set of results apparently conflicted with another, just as they do today, and only gradually do certain facts emerge, often somewhat different from any envisioned by the early researchers.

One of the most interesting truths is that the various properties of paper, paperboards, and boxes made from them are not affected in the same way by moisture in the atmosphere in which the material is stored. Increase in moisture content may increase test results on one property but decrease them on another property. Furthermore, the results of tests on one property, while the moisture is changing, may increase over part of the range and decrease over another part. Temperature is a factor and time required to reach equilibrium is important. The point of equilibrium may be different when approached in different ways. Knowing these conditions now, we realize why there was much difficulty in trying to find the facts in the beginning. However, more important to us today at our present state of knowledge is the lesson that we should not draw general conclusions from a limited set of test results.

Some facts have been fairly well established. One important one to us is that it takes time for a fabricated board to reach a state of equilibrium of moisture content when brought into a stabilized atmosphere after having been exposed to a different one. A piece of paperboard in an uncontrolled atmosphere is changing in its properties all the time, as the atmospheric conditions change, but there is always a time lag. This depends upon the magnitude of the change made, how the specimen is exposed, and the kind of material it is. A small piece of paper, completely exposed, may change radically in a few seconds, but a piece of combined board may take many days to be fully affected by a large change in conditions.

Another fact that eveyone knows, but sometimes forgets, is that when the atmospheric conditions were defined, not only the relative humidity must be stated, but also the temperature. This is particularly true at extremes of both temperature and relative humidity.

There has been much controversy as to whether the moisture content of a piece of paperboard and, consequently, its various other properties, depended upon the relative humidity or the absolute humidity of the atmosphere in which it was stored. Some careful studies seem to have established that, if the relative humidity is maintained constant, an increase in temperature, and consequently an increase in absolute humidity, will increase the moisture content of paperboard in the range above 60°F., but it will decrease the moisture content in the range below that temperature.

Another point for the engineer in this field to remember is that there is a phenomenon known as hysteresis in operation. In this connection, this means that, if a paperboard which is conditioned at a certain constant relative humidity has been stored previously at a lower relative humidity, it will reach equilibrium at a lower moisture content than if it had been stored previously at a higher relative humidity. The difference can be as much as 10% of the moisture content when the relative humidity being used is 65% or about 5% of the final moisture content when the storage atmosphere is at 50% relative humidity.

Some of the investigators who have experimented in this area report that after paperboards have been subjected to extremes of humidity or dryness they are affected permanently and some of their properties have been changed, as, for example, a loss in resiliency or ability to withstand impact forces after subjection to very dry atmospheres. This may be true although at our laboratory the only such effect we have found is an increase in toughness after storage for a suitable period under conditions of very high humidity. At high humidities paperboards attain equilibrium at a high percentage of moisture. In one series of tests, it was found that after 137 days stored at 90% relative humidity and 34°F. temperature, corrugated boxes contained from 18 to 19.5% moisture, while after storage at the same relative humidity but with an 80°F. temperature, the amount of moisture in the board was 20.5%. Raising the relative humidity to 97% increased the amount of contained moisture to about 27%.

As was stated before, the various properties of paperboards change in different ways as storage conditions change. When the relative humidity increases, the tearing strength increases, too, but the stiffness of board decreases; stretch and folding resistance increase but bursting (Mullen) resistance changes both ways, decreasing slowly from about 40 to about 80% but decreasing rapidly above 80 and below 40.

It may appear that much of the data so far disclosed is not pertinent to the subject of high humidity tests on boxes but, since our real problem is devising means for testing boxes under the stated conditions, it is necessary to have a firm grasp of these phenomena in order to avoid serious mistakes in our choice of possible courses. Incidentally, anyone who understands these facts will realize at once that tests made on unconditioned specimens have practically no value and could be misleading to a dangerous extent.

Another important aspect of a high humidity testing program is that it, like any other testing project, must be based upon the field conditions which are to be simulated. Since storage warehouses (except cold storage), railway cars, motor

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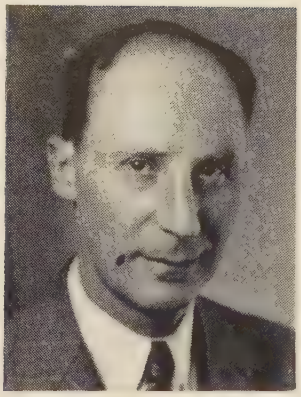
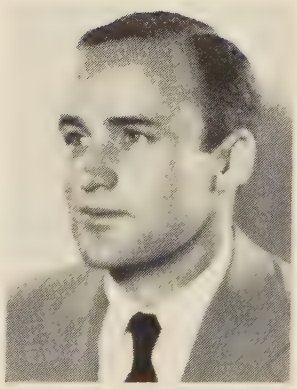


C. J. Zusi, Container Laboratories, Inc.



D. C. Shepard, Jr., Menasha Woodenware Corp.

trucks, ships' holds, and other areas through which containers normally move from the manufacturer of the product to the consumer, seldom contain controlled atmospheres, it is evident that the worst conditions likely to be encountered must be reproduced. The conditions of actual use also are changing frequently and, therefore, some time measurement must be anticipated. Failures under highly humid conditions probably will be due to piling loads such as simulated by top-to-bottom compression tests or, possibly, crushing during movement as occurs in end-to-end compression tests. In some cases, high or low temperatures will be a factor. Always it must be remembered that most of the failures will be in containers which have been weakened by encountering one or a series of hazards preceding the one directly causing the failure. Condensation due to variations in surrounding atmosphere can be a serious factor.

With these circumstances in mind, we recognize easily that the laboratory director planning high humidity tests on boxes has no simple task.

The practical details present as many difficulties as the theoretical considerations. Boxes occupy large volumes; a fairly high number of specimens must be tested to obtain reliable results; the boxes must be arranged so that all are affected equally by the storage atmosphere in which they must remain for long periods for conditioning yet the maintenance of controlled high humidity in large volume is difficult and expensive. Testing equipment deteriorates rapidly in a wet atmosphere but the specimens tend to lose the effects of extreme conditions of storage when moved into an ambient atmosphere. Ingenuity must be exercised to meet the challenge of these difficulties. At The Institute of Paper Chemistry, for example, many high humidity tests have been carried on in a huge pliofilm ballon kept inflated with high humidity air to surround both specimens and workers. A projection permits boxes still inside the ballon to be positioned on the platen of a compression tester, which is outside of the ballon. Recently, some multiwall paper sacks were tested after high humidity conditioning with the sack enclosed in a pliofilm cover while it was subjected to a performance test.

Thus, in spite of difficulties, a fair number of tests have been made to determine the effects of high humidities on corrugated boxes. These tests have included top-to-bottom resistance, effect on fatigue on piling resistance, adhesives and tapes used for closures, tapes at manufacturers joints. Containers for fruits, vegetables, meats, butter, eggs, and other food items or articles for export have been included. Since we really have made only a good beginning in the development of corrugated boxes capable of meeting high humidity conditions, many more tests must be made. Technicians directing them should keep in mind facts such as those discussed in this paper.

Q.: How is the speed of the corrugator affected by sulphu treated corrugating medium and to what extent?

Mr. Shepard: We impregnate at the corrugator, and the spee is slowed down because of this. With 42-42-lb. liners and sulphu impregnated medium, speeds of 290 to 320 f.p.m. are obtaine With heavier liners, the speeds decrease accordingly.

Q.: Having made both laminated medium board and sulphu impregnated board, can you compare the performance of th two under high humidity cycling?

Mr. Shepard: The reason for replacing laminated with sulphu impregnated is to lower cost. There is some indication tha laminated does not stand up as well as sulphur-impregnated i fatigue characteristics at high humidities.

Q.: When making laminated medium board, what kind o adhesive is used to laminate?

Mr. Gardner: The laminating adhesive should be at least a good as that used to bond the liners.

Q.: What is the approximate cost of sulphur impregnatio per 1000 sq. ft. of combined board?

Mr. Gardner: We are not in position to give an exact answe but you can figure it for yourself, approximately, basing it on th cost of sulphur and the cost of the impregnation operation.

Q.: Is sulphurization a more economical way of getting th wet strength you need than increasing the basis weight of th sheet or using wet-strength resins? I ask this because you sai that the high humidity loss of the sulphurized board is no les than that of plain board.

Mr. Gardner: On a poundage basis, sulphur is cheaper tha fiber or wet-strength resins. The interest is in wet stiffness an not wet strength. We are convinced that, economically, we ca get better wet stiffness results with sulphur than with wet strength resins or more fiber.

Q.: What temperature and humidity conditions would yo recommend for test conditions to simulate worst overseas shipping or storage?

Mr. Zusi: It would be best to know what the conditions o actual use are likely to be, and then simulate along those lines Various types of moisture exposure might be tried, such as con ditioning the boxes for 2 weeks at 90% R.H. at 100°F., or im mersing in water for 24 hr. Sometimes a water spray would b useful. If it is expected that the boxes will be stored outsid after overseas delivery, then a combination of moisture exposur conditions may be useful; for example, a spray with water fol lowed by 90% R.H. at 90 to 100°F. for 2 weeks.

Q.: Does sulphur-treated board present a fire hazard?

Mr. Gardner: In our experience so far, this has not been an problem, and we do not think it creates a fire hazard. Burning of waste sulphur-impregnated board may represent a hazard from the SO_2 resulting.

Q.: The three starch formulas call for regular pearl starch in the carrier portion. Is this significant?

Mr. Fletcher: No.

Q.: What is the effect of high temperature in conjunction with moderate relative humidity (say 40 to 50%) on a case sealing glue?

Mr. Sederlund: As long as relative humidity is in this range the temperature is no problem, even if it is very high.

Q.: How does sodium silicate sealing adhesive stand up under high humidity conditions?

Mr. Sederlund: Sodium silicate falls in same range as borated dextrins. They are pretty good for high humidity conditions but not for water immersion conditions.

Q.: Does the pin adhesion test indicate weaker bond between corrugating medium and liner when sulphur-treated medium is used, other things being equal?

Mr. Gardner: The pin adhesion test results have been shown to be as good with sulphur-impregnated as with regular corrugating medium. At high humidity it appears better because regular corrugating medium appears to disintegrate more than sulphur-impregnated.

Q.: What is the advantage of using a ketonic resin for weather-proof work in sulphur-treated medium corrugating?

Mr. Fletcher: The advantage of the ketone is that you can use an adhesive on the alkaline side and take advantage of the increased tack, and you do not have to wash out the system for each use as you would with acid resin pastes.

Q.: At what speeds do you run the different corrugators with sulphur-impregnated medium?

Mr. Gardner: When running sulphur-impregnated medium, speed is slowed down to some extent as compared to regular medium.

Q.: When running sulphur board on the impregnator, do the fumes cause any problems of toxicity to the workers?

Mr. Gardner: There are no toxic fume difficulties, as the operation is hooded to exhaust any sulphur fumes to the outside.

Q.: Have you compared sulphur-impregnated with laminated and heavy corrugating mediums of 38 to 40 lb. per thousand sq. ft.?

Mr. Gardner: We are not in position to give any data on com-

parisons of sulphurized medium with heavy or laminated media. Any such comparisons should be with the same liners and corrugations, etc.

Q.: What effect does sulphur have on the corrugator parts from a maintenance point of view?

Mr. Shepard: It does have some effect, particularly on those parts exposed directly to the medium. We think that sulphur may affect bearings. It contaminates the glue and requires cleaning out occasionally. The sulphur tends to disintegrate the copper lubrication lines which oil the glue and applicator rolls. On some of the new single facers, this trouble would be avoided, since the glue rolls are lubricated by grease, eliminating oil lines underneath the web.

Q.: Can you give any idea of the magnitude of changes in paperboard properties as the relative humidity changes?

Mr. Zusi: At the time we changed our conditioning from 65 to 50%, we had indications that the following had occurred: bursting test increased 3%, puncture test showed no significant change, ring stiffness and compression tests both increased 10%.

Q.: Is it satisfactory to thin down bottle labeling glue and use it for hand case sealing in order to avoid stocking glues for each purpose?

Mr. Suderlund: The results would depend on the kind of adhesive being used. Some gums would be OK, but if canary dextrin is involved, the double use may be unsatisfactory, because canary dextrin is sensitive to high humidities.

Q.: Would you get better adhesion if a modified starch were used in the carrier instead of pearl starch?

Mr. Fletcher: Yes, you would, because solids and tack would be increased. However, the adhesive cost would also increase.

Heat Balance and Its Effect on Corrugated Board

D. P. McNelly (Fort Wayne Corrugated Paper Co.): I do not think anyone here would quarrel with me too seriously if I said that the corrugator-doublebacker is the heart of a box plant. There is not much question that it is the most important single machine, although this does not mean that there are not other important and vitally necessary machines in a plant. It is the heart, because it is the first, the largest, and most expensive machine used to make a corrugated box.

To complete the first operation in the manufacture of a corrugated box, we must bring together five different elements. We must have a machine, a corrugator-doublebacker, in good working order. We must have materials to corrugate, liner board, and corrugating media. We need adhesives to stick the board together. We must have a crew of trained men to operate the equipment. Last, and not least, we must have heat in the components of our machine to condition the materials properly and to set the adhesives to hold the two, three, or five members of paper together to make corrugated board.

We are here to discuss the fifth element, heat. Heat is definitely an important factor in the corrugating operation. If we have too little heat our speed is reduced, increasing our cost, and the proper bond is not formed. If we have too much, again the proper bond is not made and our quality is not satisfactory. If we have too little or too much heat, anything except the proper amount for the conditions then existing, the amount of waste, the most important single element of cost in the box plant, is increased.

Modern Condensate Drainage Control for Corrugators

R. J. LUNDRIGAN

We are certain that those who have studied the problems concerned with maintaining quality of board while increasing the operating speed of a corrugating machine recognize the importance of adequate condensate drainage.

Excellent drainage is essential and has a direct influence on latent heat transfer to the product and uniform heating surface temperatures. If good drainage can be combined with high temperature condensate recovery, steam cost can be substantially reduced for greater plant efficiency.

R. J. Lundrigan, Manager of C-B Div., Cochrane Corp., Philadelphia, Pa.

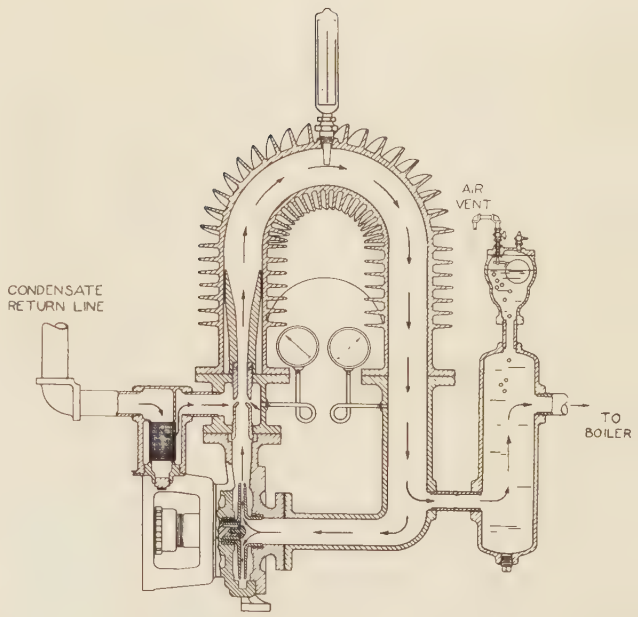


Fig. 1

Before discussing the merits of the Cochrane system, we will briefly relate a few of our early experiences in this industry, which will qualify our later statements and explanations.

To our knowledge, during the late thirties, comparatively little attention was paid to this important feature of corrugator operation. As many and varied so-called drainage systems existed as there were individual opinions as to how the problem should be solved.

Basically, however, most systems could be generally classified as "open," where either by the use of traps or flash tanks, the eventual destination of the condensate was to an open receiver or heater in the boiler room, from which it would be recovered by the conventional boiler feed pump for return to the boiler at temperatures rarely exceeding 210°F.

Today the plant operator might well check the answers to the following questions:

1. Do I have adequate and uniform surface temperatures on all rolls, preheaters, and plate surfaces of the machine?
2. Does lack of quality of the board at the take-off end of the machine govern operating speed?
3. Can I produce satisfactory board at higher machine speeds?
4. Is the condensate from the corrugator returned without flash loss to the boiler at the approximate temperature of the steam pressures utilized?
5. Can I reduce my steam cost per board unit?
6. Does the present system require more than average maintenance?
7. How much have I invested in the return system?
8. Is there an adequate return on this investment?

The very first installation of our system consisted of superimposing it on a corrugator already in operation and the results obtained were quite startling. The operator addressed the following communication to the manufacturer of the corrugator involved:

"Our installation is working fine and giving greater heat efficiency than we have ever before had on the machine and also effecting a decided fuel and water saving. This system speeds circulation and in our case returns condensate to our boiler after traversing the entire plant through the corrugator at only 10 to 15°F. under the initial temperature of the steam when it leaves the boiler."

From another installation a short time later we had the following comment from the operator of a plant then making double-wall board on a military contract where every known

method for achieving greater production of this heavy sheet had been previously exhausted.

"We are highly pleased with the results of our CB installation. Our normal production consists of about 25% double-wall, 35% combinations of 0.030 liners, and the remaining 40% of 0.16 grades. The speed of both 0.030 and single-wall and all grades of double-wall was increased in excess of 100 f.p.m. over our former production. We are also getting a drier and harder board at the high speed. Our return line thermometer shows a reading within 10° of our boiler temperatures, and the return is made with no flash loss."

This company now uses this system in all of their corrugating plants numbering over 20.

This was followed by a third comment concerning the initial installation in the organization now using nine of these systems by an individual considered to be among the experts in this industry, as follows:

"The CB has unquestionably increased the maximum temperatures of the rolls and plates in the machine, but what is more important, it has decreased the drop in temperature which occurred while running wide widths at high speeds with the old system. In fact, with the CB system we get practically no temperature drop whatsoever, thus materially improving the rate of heat transmission from the heating units into the board itself. It goes without saying in consequence the temperature of the board at the knife end of the machine is considerably higher than before. All of these things combined to get us a much harder and better stuck sheet at the end of the machine. We have, of course, been able to increase the speed at which we can make satisfactory board with heavy liners and wide widths."

As this last comment more concisely describes the results that are obtained and as this performance has been repeated over and over again, as we have installed this system on more than 50% of all of the corrugators in the United States, we will attempt to explain why.

Figure 1 shows a cross section illustrating the design of this device, known as the CB unit, which is normally located in the boiler room. It consists of a jet pump installed in a circulating loop and energized by a continuously operating, specially designed centrifugal pump that is always primed at the suction by its own discharge pressure.

The condensate return line from the corrugator is connected into the jet pump housing with the discharge line connected into the boiler feedwater header. Thus, a "closed" circuit is created with the steam flowing from the boiler to the corrugator and condensate back to the boiler through the CB unit.

The stainless steel fitted jet pump has the characteristic advantage that it can endure the entrance of a flashing mixture of steam and water without erosion. It does not become steam bound because it is installed in series with the centrifugal pump which provides compression for the jet and creates the effective head necessary to deliver a solid stream of water regardless of the temperature, back into the impeller suction. Any entrained vapor is condensed by this compression. Radiation from the thermofins, which are an integral part of the recirculating loop, removes any excess temperature due to motor input when condensation is not taking place in the corrugator.

Any excess liquid drawn into the jet pump and loop is automatically ejected from the loop through an air separating chamber back to the higher pressure boiler feedwater header without loss of temperature except that due to radiation from the entire circuit. Normally, this loss does not exceed 10°F. from the temperature of the steam pressure utilized by the corrugator.

The utility of this unit, just as a means of salvaging condensate at high temperature from the corrugator and discharging it back to the boiler without any flash loss or appreciable drop in temperature, is one of the factors that assures minimum steam cost for the operation.

The air separating chamber with its automatic vent to atmosphere assures the quality of the condensate for the boiler to be equal to, and not worse than the water supplied to the boiler by the make-up pump.

It will be noted from Fig. 2, that this unit is installed normally in the boiler room with the condensate return line draining the corrugator connected to the inlet side and the discharge from the unit being into the boiler feedwater header.

The "jet" action withdraws condensate, gases, and air from the return line at the same velocity as condensation takes place in the corrugator. There is no appreciable pressure drop across the condensate outlet orifice from the condensing chambers of the corrugator. Hence, temperatures are stabilized at the highest possible point consistent with the steam pressure used.

Condensing chamber walls are free of excess film at all

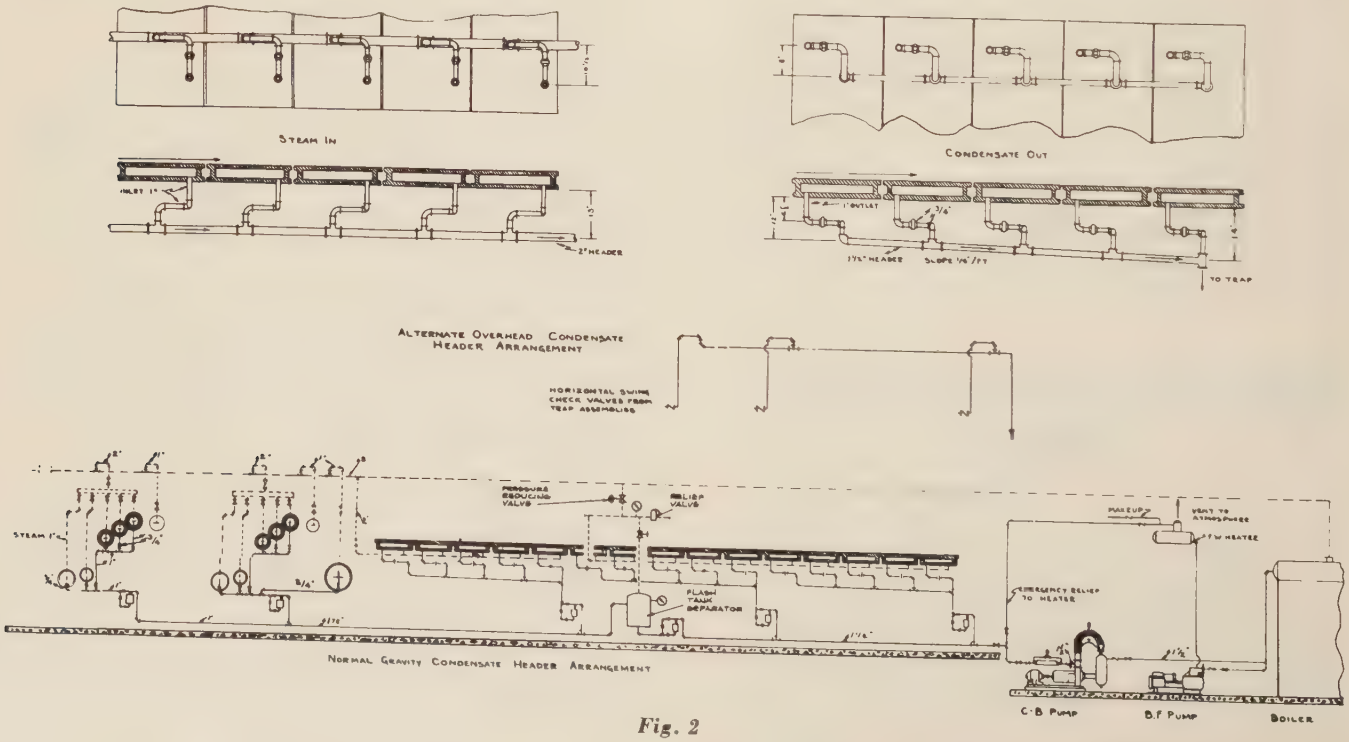


Fig. 2

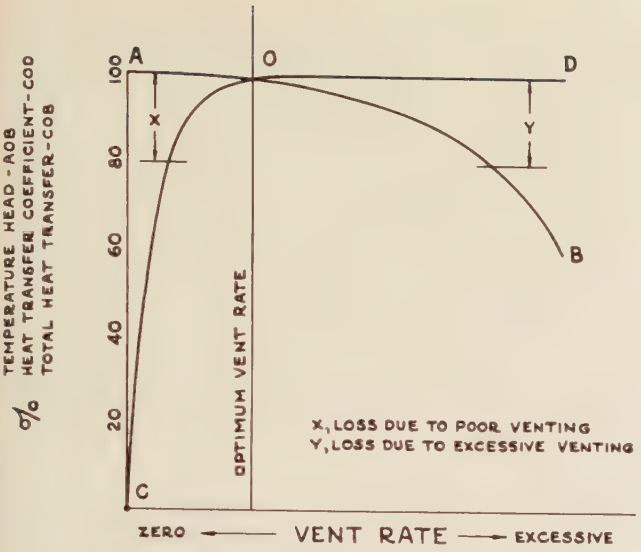


Fig. 3

times with no impairment of heat transfer. Condensate and any gases and air released by the condensing steam are removed with equal velocity. Surfaces are uniformly hotter with the same steam pressure than is experienced with an "open" system of drainage. Board travel speed can be maintained at a maximum and uniform rate. Difficulties relating to poor drainage are eliminated.

Condensate return lines can be overhead or gravity as conditions warrant. Actually, gravity lines are the most desirable with any kind of drainage system.

The corrugator shown can be operated with the highest steam pressure on the single facers, preheaters, and the first section of plates, this latter being optional. Condensate from this section flows through traps to a common header which is balanced by a flash line with the steam supply header utilized on the remainder of the double-backer plates. This latter pressure is regulated at option by a pressure reducing valve from the main steam supply. The flash fitting and the double-backer plates are trapped into the common return line leading to the jet housing. Steam supply for the showers is taken from the main supply line.

The condensate flow from each group of rolls, preheaters, and plates is controlled by an inverted bucket trap equipped with a needle valved by-pass. When the unit is put into service these valves are set to balance the system and no further adjustment is required. The traps are sized for an "open" system where the pressure drop from the steam pressure utilized to zero would normally prevail across the trap.

As the condensate flows into the return line at a temperature close to the steam pressure utilized and as the jet pump discharges to a higher pressure obviously the pressure in the return line is stabilized at the corresponding temperature of the liquid. This automatically establishes a relatively small pressure drop across the condensate outlet from the condensing equipment. The liquid is extracted from the return line by the jet pump and the line is maintained in dry or vaporized condition due to the small amount of flash steam that is created by the small pressure drop. Only a negligible amount of compressed steam enters the venturi.

This high back pressure imposed against the valve mechanism of the trap automatically adjusts the condensate flow rate as controlled by the valve mechanism so that normal intermittent trap action is converted into a modulated flow and the trap becomes a control device opening consistently with the condensate volume involved and closing in the presence of complete steam flow such as would prevail when the corrugator is noncondensing.

This results in continuous flow of condensate, gases, and air from all steam chambers at the exact rate these elements are formed, with disposal accomplished through this ideal orifice across which the absolute minimum pressure drop is created.

No known means that is practical exists whereby an operator can establish a continuous flow at the ideal vent rate from a condensing chamber without either excess losses of steam pressure and temperature head or excessive accumulation of condensate, gases, and air in the condensing medium.

To illustrate the consequences of either improper venting or excessive venting refer to Fig. 3. Curve AOB shows the available temperature head with the variation of vent rate. Curve COD shows variation of heat transfer coefficient with vent rate. The net total heat transfer rate is the product of values read from these respective curves and identical to a curve through COB. The optimum (or ideal) vent rate would be at point O.

The ideal vent rate is more closely approximated with the use of use of the CB unit than in any drainage system design we have ever analyzed that is practical in service.

These conditions establish maximum heat transfer under variable flow conditions and this important factor enables better quality control, higher speed in operation, and in our opinion, is the principle that can be utilized as this industry strides for speeds in excess of 700 and toward the 1000 f.p.m. goal, now so freely predicted for the future.

While it is possible to utilize fixed orifices in place of the trap by-pass assembly described, experience teaches that the flexibility of the latter outvalues the economy of the former and trap maintenance is no problem in a "closed" circuit where mechanical violence in trap action is minimized by the cushioning effect of the small pressure drop involved.

It has been found that the industry, in general, does not respond to suggestions for more elaborate instrumentation for close control of pressure and temperature conditions.

While it is recommended that more serious consideration be given to this subject, we can say that this CB system requires less instrumentation for good results, but it will also function to the highest degree of efficiency in conjunction with instrumentation no matter how elaborate.

If a drainage system is providing adequate condensate elimination with maximum latent heat transfer, then control is easily established by adequate pressure control valves and accurate pressure gages in the steam lines.

No more than the normal heat loss through the metal of the heat transfer surfaces need be expected or experienced.

As this system correctly installed on a corrugating machine, will answer satisfactorily all of the questions in our previous questionnaire, we offer it together with our many years of experience to the corrugating and paper industry to help establish operating conditions difficult to attain otherwise.

By combining the thermal efficiency thus obtained with the almost complete recovery of the B.t.u.'s involved, this system can actually increase production and improve the quality of the product while reducing the steam cost.

It represents, therefore, one more progressive step in the never-ending battle for greater plant efficiency.

The Detrimental Effect of Either Excessive or Insufficient Heat on Corrugating Board Starch

C. R. VANDER MEULEN

It is interesting to consider that starch and cereal flour pastes were among the first adhesives used in the manu-

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facture of corrugated board. The early machines made use of the principle which is still in operation. The paper was passed between two intermeshing fluted metal rolls with the paper being dampened to make it pliable and the rolls being heated to hold the corrugations. Heating of the rolls was accomplished by hot pokers and later with gas. The adhesives were inadequate since they required large amounts of heat and time to set. The adhesive was applied over the entire inner area of the double backer liner and the combined board was stacked on trucks in front of suction fans so that air could be drawn through the corrugations to dry the paste (*1*).

The advent of silicate of soda as an adhesive was a big factor in the early changes in design and operation of corrugating machinery. Silicate has the characteristic of marked increase in viscosity with small loss of water or minimum of heat and this permitted faster bonding. Silicate continued as the principal adhesive until the late thirties when the gelatinization *in situ* process using starch was developed and patented (*2*). It was necessary to develop the starch adhesive so that it would operate under the conditions used for silicate, i.e., having a similar viscosity system, able to form a bond under similar conditions, and competitive economically.

In this modern process, the starch suspension is changed from a fluid, relatively nonadhesive form to one which is extremely viscous and exhibits a strong suction bond immediately. The gelatinization temperature of starch used as a corrugating adhesive is lowered by the use of small amounts of caustic. With a relatively small increase in temperature, the granules swell suddenly, increasing many times in size, and take up moisture with a rapid increase in viscosity. The function of borax is to serve as an effective agent for further increase in viscosity. It is the sudden and extreme increase in viscosity which results in the initial bond and the time required to form this initial bond is not dependent on the loss of moisture but on the time required to effect sufficient heat transfer to reach and exceed the gelatinization temperature of the starch. After this, it is necessary only to have sufficient heat to dry the board without overheating or deteriorating the board components and the adhesive film.

If the temperature to which the board and adhesive film are subjected is excessively high, the adhesive bakes and becomes brittle similar in appearance to a deep fat-fried carbohydrate. The result is a brittle bond or board which is frequently called "snappers," the term obviously being derived from the sound as the board is flexed or as the liner is peeled back. This condition occurs most frequently on the outer liner or double-facer side of the sheet and it is likely to happen during a slow-down or on that portion of the board under the belt when the machine is stopped. However, it can and does sometimes happen at the single facer under very high heat conditions. Too much heat may also adversely affect the paper itself, causing it to become weaker. If, under normal operating conditions, difficulty is being experienced with too much heat, the temperature of the hot plates may be reduced. Many plants have divided the hot plates into sections with reducing valves in the steam lines so that a controlled reduction in temperature may be accomplished. The pressures are being decreased from 175 to 200 p.s.i. in the first section to 90 p.s.i. and as low or lower than 50 p.s.i. in the last section. The speed may be increased to shorten the time of contact with heat or the application of starch may be increased to obtain the cooling effect of increased evaporation.

When the starch adhesive is first heated, there is only a comparatively small change in viscosity and, if allowed to cool before reaching the gelatinization temperature, there will be no obvious changes in the characteristic appearance and birefringence of the individual granule. Therefore, if any insufficient amount of heat is available, either of two conditions may occur. The adhesive may not reach the temperature required for complete hydration or water may be absorbed into the paper so that there is an insufficient amount present for complete cooking of the starch. A defective bond will result and a grayish or white cast in the glue line is evidence of the lack of heat. The adhesive bond under these conditions will be very weak, somewhat similar to that obtained with a low solids adhesive since only a small portion of the starch will be effective. When double faced board is produced, even with fairly high temperatures on the machine, one may encounter incomplete gelatinization of the starch due to the insulating effect of the lower single-face component.

If board exhibiting a weak bond is being made, one should first check the steam pressure and, more important, the actual temperatures of the corrugating rolls, preheaters, and hot plates. Specially designed steam circulating systems are available for increased steam efficiency. Adequate preheating is prescribed and lower gelatinization temperatures may be advisable.

Indirectly, the heat used on the paper machine for drying the paper may have an effect on the adhesive used on the corrugator. Incomplete drying or board with a moisture content causes difficulty, possibly because too much heat is dissipated in driving off this moisture, preventing the board from reaching a temperature necessary to gelatinize the adhesive. There exists also the possibility of sufficient hydrastatic pressure of vapor in the interstices of the fibers to prevent penetration of the adhesive. Paper which has been dried excessively, in addition to having lost some of its strength, is difficult to bond, possibly because the fibers are closer together, causing a reduction in size of the air spaces and a more dense sheet. A consensus indicates that moisture contents of 8 to 9% in the corrugating medium and 6 to 7% in the liners is most favorable. Board components of less than 3% moisture usually are difficult to handle because of improper fluting and the presentation of a hard, not readily wetted surface.

It is of interest to consider further the gelatinization temperature of the starch adhesive and specifically the amount of heat required for hydration. At the single facer, the gelatinization temperature must be low enough to permit quick bonding but not so low as to cause trouble with gelling on the fingers and in the pan. Good circulation in the pan, circulation of air above the pan, and water-cooled splash guards and pan are preventives for gelling difficulties. Normally, the gelatinization temperature is recommended to be in the range of 142 to 144°F. However, some plants have adopted the two-starch systems in which the amount of caustic used in the single-facer formula is decreased while the double-backer formula has an increased caustic content for still lower gelatinization. In this case, the gelatinization temperatures may be in the range of 150°F. or higher at the single facer and 136 to 138°F. at the double backer. It is not practical to attempt gelatinization temperatures below 135°F. because the amounts of caustic required then become sufficient to cause a thickening of the starch, in time, at low temperature or without the presence of heat. Now, assuming the temperature of the adhesive to be 100°F., which is the normal range, and considering only the energy required to heat to the gelatinization temperature, a difference of only 12 B.t.u. per pound of adhesive is required for the starch at the double backer and that at the single facer. With steam pressure at 175 p.s.i. and heat transfer at 50% efficiency, approximately 513 B.t.u. are available per pound of steam. Therefore, there is a difference of only 0.023 lb. of steam required (per pound of adhesive) in cooking from 138 and 150°F. This seems almost negligible except that the matter of time required to reach the cooking temperature is considered of great importance.

The detrimental effect of an insufficient amount of heat is easily corrected and therefore offers little or no problem. The ever-increasing speeds of corrugators with proportionate increased heat capacities offer a more challenging problem. If we take, for example, a speed of 600 to 700 f.p.m. and modify heat conditions for this speed, then obviously there will be

too much heat present in the equipment for start-ups or splices or running at lower speeds. A corrugating machine, regardless of whether it has been heated by means of steam or hot oil, will, due to its mass, remain hot for an appreciable length of time. Therefore, it does not seem that mechanical means are available for adjusting the heat to its most effective level for speeds of 100 and in excess of 600 f.p.m.

The only other obvious solution, after accomplishing all that can be done mechanically, is to consider variations or modifications in the adhesive, itself. We have been making some tests and observations in connection with adhesive changes for high-speed operation on equipment having large heating surfaces and high temperature. One change in adhesive formulation which appears to offer some encouragement and which should be investigated further is a reduction in the amount of borax used in the formulation. It will be recalled that the prime function of borax is to increase the viscosity of the starch as it is pasted *in situ*. For the higher speed corrugators or, for that matter, for board which is dense and hard or difficult to paste, we should formulate so that the adhesive cooks properly but remains in a penetrating or more fluid state for a slightly longer time. This should allow the adhesive to penetrate sufficiently to a subsurface position in both the liner and corrugating medium and insure a bond less subject to embrittlement. A reduction of, say, 50% in the borax content of corrugating starch adhesive is not quite so simple as it may appear, because borax also serves another function. If it were not for the presence of borax, the caustic soda would be more effective in reducing the gelling or pasting temperature. Therefore, if borax is reduced, it may also be necessary to reduce the caustic content. The adhesive formulations at the different plants will have to be treated as individual problems, because of the varying heat conditions involved. In addition to lowering the borax so as to produce an adhesive which remains a little more fluid for a little longer time, it is also recommended that the solids content but not the viscosity of the corrugating starch adhesive be increased. It should be kept in mind that it is necessary to finally arrive at a very high viscosity, sufficient to form the suction or initial bond, and if the borax content be reduced to delay or lower this viscosity it is necessary to use more starch solids so that upon a very small amount of drying the adhesive will finally reach this high viscosity.

The development and use of precision instruments to determine moisture and, conversely, the effect of temperature on board is recognized and we believe with the high-speed corrugators it is more important now than ever before. One other factor which might receive further consideration is the introduction into the adhesive of a plasticizing agent which exhibits high humectant properties. The use of such a plasticizer, it might be argued would be good insurance against excessive drying or embrittlement of the adhesive. However, in making this statement, we do not wish to detract from the necessity of changing adhesive formulation for high-speed corrugators so that there is opportunity for the adhesive to wet or penetrate the components before the water is removed from the adhesive. It should not be too difficult to demonstrate the effectiveness or advantages of a change in formulation so as to effect greater penetration on high-speed hot machines. Board could be produced with the different adhesive formulations and sections sliced with a microtome knife and the depth of penetration of the adhesive studied under a microscope.

In closing, we would also like to briefly discuss the increasing importance of bound water in connection with the high-speed corrugating machines. An appreciable amount of the water present in a corrugating starch adhesive is free water. The only water of hydration or chemically bound water present is in the carrier portion. The principal function of the carrier is to suspend the raw starch portion and keep it from settling. However, it has also been pointed out that an important function of the carrier is to chemically tie up a large portion of the water in the form of a hydrate (*3*). If the carrier, due to faulty preparation or improper formulation, contains an appreciable amount of free water, it will wick away from the adhesive on the flute more rapidly on the higher temperature machine. The carrier may be prepared from new or modified starch derivatives which insure practically 100% bound water.

It is hoped the suggestions made above will prove of assistance because, undoubtedly, as speeds and temperatures increase, the detrimental effect of excessive heat at the wrong time or wrong place will assume more and more importance.

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Conventional Steam Trap Systems

CHARLES D. NITCHIE

An efficient steam system is an extremely important factor in our highly competitive industry. There are five basic things required of a steam system: (1) good flute formation, (2) quick setting of adhesives, (3) warpage control, (4) simplicity of operation and maintenance, and (5) economy of operation.

The first two are perhaps the most important to your operation, as they determine the speed at which the combiner may be run and the quality of your product.

While a steam system alone cannot insure high caliper and good flute formation, it is common knowledge that an otherwise mechanically perfect single facer simply cannot turn out a quality product at high speed with inadequate temperatures at the corrugating and pressure rolls.

What has heat to do with flute formation? First of all, steam must be used to moisten the heat and paper to plasticize it or take the springiness out of it and make it receptive to corrugation without fighting back. Next, the flutes as they are formed must be very quickly heated to mold in the shape of the roll teeth and drive off the moisture which has been introduced to return it to its original stiffness.

This same heat is also important in setting the adhesive. If we consider that when running B flute board at 600 f.p.m., an individual flute is in contact with the pressure roll only $^1/_{520}$ sec., the requirement for high temperature becomes clear.

At the double facer, the need for quickly setting the adhesive is again important. Here the time factor is not so acute, but in the absence of pressure, more time is required to allow the heat to penetrate through the bottom liner. If, however, high and low flutes have been made at the single facer, the double-facer bond will be poor. It, therefore, becomes apparent that the basic requirement of the steam system is to maintain the highest possible temperatures at the single facer.

The laws of physics decree that for heat to flow, there must be a difference in temperature and that the greater the temperature difference, the higher the rate of flow. We are attempting to transfer heat from the rolls to paper, thus our object is to obtain the highest possible temperatures at the surfaces of the corrugating and pressure rolls.

This means that the steam fed into these rolls must be of a high temperature and must be in a condition to give up the maximum number of B.t.u.'s to the roll walls immediately upon contact. Dry saturated steam is best suited for this purpose, as it is ready to immediately condense and give up its latent heat vaporization which is its greatest component of heat

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energy. Just as it is the function of the boiler to generate steam of this ideal quality, it is the function of the steam system to utilize this steam in such a way as to effect the greatest possible heat transfer to the walls of the various heating elements on the machine. This means that the system must remove all obstacles to heat transfer. What, then, are these obstacles?

First of all, any potable water supply contains oxygen and other gases, either dissolved or entrained in it as bubbles. When such water is boiled, these gases are liberated and leave the boiler mixed with the steam and enter the rolls. Since these gases are noncondensable, they may, if properly handled, become pocketed in the rolls where they act as insulators and seriously cut down the heat transfer. It is interesting to note that experiments have proved that the film coefficient of heat transfer can be halved by adding as little as $^1/_2$ of 1% air to air-free steam.

The second obstacle is water which is also an insulator.

Fortunately, the solution to getting rid of both these obstacles is the same. If the steam is passed through the rolls at high rate of flow, the noncondensable gases will be swept through it and will not have a chance to accumulate. The same rapid flow will scrub the condensed water from the walls, allowing intimate contact between the hot vapor and the steel, and sweep it out the siphon pipe.

The original concept of a steam system was to have a trap on each element. This required a lot of traps, and thus a lot of maintenance, but even worse, it means a very slow rate of flow of steam through each element, since the flow was limited to the steam condensed in each particular element. The flow was also intermittent, due to the intermittent action of the trap, and even though most traps have venting means built into them, they were inadequate to prevent noncondensables and water from accumulating in the element between blows, and they were never swept clean when the brief blow did occur.

To combat these difficulties, the elements were next connected in series, usually in groups of three, with one larger trap serving the group. The two corrugating rolls and pressure roll, for instance, were connected so that steam from the main entered one corrugating roll, the outlet from this roll leading to the inlet of the second corrugating roll, and the outlet of the second corrugating roll leading to the pressure roll, and from thence to the trap. Double-facer plates were similarly arranged in groups of three.

This arrangement helped the first roll as the flow was at a fairly high rate, because the steam subsequently condensed in the other two rolls had to pass through the first. The second roll was penalized by having to pass the condensate from the first roll, but the rate of flow was still fairly good because of the demand of the third roll. The third roll, on the other hand, was loaded up with condensate, air and very wet steam from which most of the latent heat has been robbed by the first two, and was thus so inefficient as to seriously impair the performance of the machine.

This caused many operators to by-pass their traps with the result that the boiler room got back more steam than condensate, and was very wasteful since much of this surplus steam had to be vented to atmosphere.

While far from the final answer, these trials pointed up the necessity for high rates of flow through the high-demand elements of the machine, and led Samuel M. Langston, in collaboration with the Stickle Steam Specialty Co., to develop the so-called Stickle steam system for corrugators.

In this system, all of the elements having high heat demand, namely, all elements of the single facer and the preheaters at the double-facer glue machine, received hot dry steam directly from the main. Each of these elements was piped to discharge steam, noncondensables, and condensate into a flash tank. Here the condensate was removed by a trap, and the steam and noncondensables passed along to heat the double facer. The steam demand of the double facer thus provided a high rate of flow and good venting through the critical single facer elements, just as the second and third rolls in the series arrangement have helped the first roll.

The disadvantages of the series system so far as the double facer was concerned were minimized by removing the condensate at the flash tank before sending it through. By-passing or short circuiting of elements was prevented by use of orifices which tended to maintain sufficient pressure drop across all elements in the group to insure good siphoning in all.

In the double facer, the same system was followed, with the chests usually paralleled in three groups, suitably orificed to prevent by-passing, each group discharging into a flash tank and passing the remaining steam along to the next group. The last group discharged directly into the condensate return line through an orifice. This insured continuous flow and positive venting through the entire system.

The Stickle system was a great step forward and pioneered the way to the modern system of today. It provided sufficient flow and venting to the single facer to satisfy the heat demands of the speeds then prevalent and considerably reduced the number of traps. As speeds of machines increased, however, the disadvantages of the second and third rolls in the series system began to become apparent in the tail end of the double facer, and means to efficiently provide greater flow through the entire machine had to be devised.

There are several good steam systems on the market today, but the one which has been installed on the vast majority of new machines we have built over the past 8 or 10 years is the so-called Langston steam system, which was designed and patented by Walter J. Goettsch, vice-president of our company. It is a direct descendant of the Stickle system, but efficiently overcomes its disadvantages.

Mr. Goettsch recognized that the steam demand on the showers on any unit represented normally from 10 to 20% of the total steam demand. He reasoned that since this rather substantial quantity of steam had to be discharged to atmosphere anyway, it could very advantageously be made to carry with it the undesirable noncondensable gases, and at the same time efficiently augment the flow of steam through the entire unit.

In this system, steam directly from the main is supplied to the single-facer and double-facer glue machine elements, which are provided with suitably large pipe sizes and orifices regulating flow through the secondary elements, such as preheaters.

Discharge lines join together and discharge into a simple but efficient steam separator which is nothing more or less than a small vertical tank, the entrance to which is tangential to the shell so that the entering condensate is spun outward and falls to the bottom where it is removed by a heavy duty trap having only a nominal venting characteristic. Steam for the entire double facer, as well as the steam showers, is then passed through the double facer. Note that the flow rate in venting of the most important elements of the machine, namely the single-facer and double-facer glue machine elements, has been increased by the addition of the shower demand. This is higher than in any other system we know of. There are no differential or stabilizing valves as were required in some of the early systems.

The arrangement of the double-facer plates varies somewhat with the size of the unit, but generally is very similar on all machines. The typical high-speed 29 plate double facer is arranged as follows: steam from the first separator is passed through the first six plates of the double facer at high pressure and with a high rate of flow because of the high heat demand in this part of the unit.

Discharge lines from each of these six plates, again of ample size, join together and terminate in a second separator identical to the first and served by a similar trap.

The balance of the double-facer steam plates are arranged

in two approximately equal groups. The steam for these is supplied by the second separator, the pressure being regulated at this point by means of a pilot-operated pressure regulating valve which provides convenient and accurate temperature control, which is so important in combating warpage.

The discharge lines from the second group of plates join together and terminate in a third separator, identical to the first two, and again served by a similar trap. This third separator supplies the plates in the third group. The discharge lines from these plates join together and terminate in a forth separator, identical to the others, and served by a trap similar to the others, but having a slightly higher thermostatic venting characteristic for aid on cold start-ups. Steam for the showers is supplied by this fourth separator.

The steam demand in the showers provides the essential venting characteristic and effectively carries the accumulated noncondensable gases, removing them completely from the system. They are not sent back to the boiler room where they might create corrosion problems, or if not effectively removed, be returned to the unit a second time. On the other hand, the noncondensables do not impair the effectiveness of the shower steam in preheating and moistening the corrugating medium.

It has been found that somewhat moist shower steam does a better job of plasticizing the sheet, particularly when used as a preconditioner shower.

The faster a machine runs, the more shower steam is required. This means the faster the machine runs, the more we increase the rate of circulation, and along with it the heat transfer rate.

An important feature of the system is that there are only four steam traps. Traps, however, are important as they permit the return line to operate at low pressure, so that only a very small amount of steam is vented into the return line, which makes the job of handling the return condensate at the boiler room very much easier.

There is no mystery about any of the equipment used. The steam traps are of the standard inverted bucket type, which are simple, rugged, and well known to any maintenance department.

In conclusion, I should like to point out that we as machinery builders are primarily interested not in selling steam systems, but rather in seeing our machines equipped with systems which will permit their optimum performance. We make a nominal charge for the drawings showing all pipe sizes, etc., which can be turned over to your steam fitter for installation. We are also in a position to furnish such items as headers, flash tanks, and traps.

There are somewhere around a hundred installations of this system running, and from observation of these and others, it is our sincere belief that this system best fulfills the requirements which were enumerated at the outset.

Heating with Hot Oil

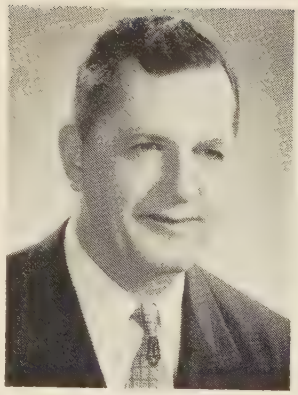
R. CASPER SWANEY

USING oil as a heat transfer medium is relatively new when compared to the use of water although it is neither new nor novel. Oil has been used for process heating nearly 50 years but for some reason its development has been slow.

Converting the standard types of boilers to heat oil has been a bleak disappointment.

Tube-still or pipe-still heaters have been developed to a high degree for use in the petroleum refining industries where they are widely used to perform continuous cracking or refining processes. A great deal of data and experience are available on such units and processes within limited circles.

R. CASPER SWANEY, The Hot Oil Heater Div., Mountain State Fabricating Co., Clarksburg, W. Va.



C. R. Vander Meulen, Penick & Ford Ltd.

R. C. Swaney, Mountain State Fabricating Co.

They are sometimes referred to as process furnaces or just plain furnaces. There are nearly a dozen styles or types all having particular features applicable to specific processes or end results. Some are limited to very low capacities because of their design. Others can be built in quite large sizes. However, the evidence indicates little thought has been given to the problem of heating oil for process until the last few years. The usual procedure has been to pick out a design, usually the cheapest, put oil in it, and start heating. Consequently, some have worked out in a measurable manner but most have left something to be desired.

A fair summation of the tube-still or pipe-still heater to heat oil for process might be: lowest initial cost, quite low thermal efficiency, very high maintenance and operating cost, and thermal instability adding to the hazard of an already hot potato.

Tub-still heaters are about the cheapest possible design to build, and for the tasks they have been designed, that is most important than their disadvantages as viewed from the standpoint of process heating.

For some reason there is a prevalent theory, or at least one that is quite widely accepted, regarding the efficiency of oil as a heat transfer medium. From all the evidence I have been able to gather it appears the inefficiency of the heat generating mechanism has been confused with the efficiency of mineral oil as a heat transfer medium. I have found that whereas extensive study and improvements have been made in refinery applications the heating applications have been relatively makeshift, or the line of least resistance.

Why has the development of oil heaters lagged? I believe it is romance and lack of competition.

Most often the first reaction from the operator is, "What kind of oil do you sell that won't burn at 600°F?" Or, "Isn't it dangerous?" We don't sell oil; it will burn; and it is dangerous.

There are many grades and makes of oil commercially and readily available in all major markets and we care not from whom the oil is purchased. We have found highly refined paraffinic oils produced by the solvent process to be best. The refiners are more than anxious to help and we have found them all most cooperative and helpful in every instance.

Heat transfer oils being petroleum products naturally are flammable. In fact, we do not know of a good heat transfer oil that will not burn; but only at the highest temperatures will most of them support combustion by themselves. Some excellent heat transfer oils cannot be ignited with an acetylene torch at 500°F. or better. But at room temperature they will burn on a wick like a candle or any good quality oil.

The practicable range for efficient hot oil heating is 300 to 600°F. with 700°F. for a little higher not far off. Now these temperatures are dangerous *per se;* just because they are that hot. Many common substances in the presence of air are

autoignescent at these temperatures; and, in fact, very few building materials are not. Thus, we find it is impossible to have higher temperatures without adequate safety measures. Therefore, we at the Hot Oil Heater Division work as closely as practicable with all agencies, public and private, especially insurance company engineering departments, on safety engineering and we can boast without equivocation that we have the safest and most efficient higher temperature heat generator we know. If there is a higher quality instrument available or one that will increase the safety and operation effectively we use it. However, we frown most obdurately upon "gadgetry." Our keynote is the utmost simplicity of design and the highest possible quality to produce a safe, efficient and reliable tool. At the temperatures our equipment operates, cheapness cannot be countenanced. Further, we know that with the wider use of hot oil heating safety codes will be written, which we most heartedly welcome, and for your benefit and all our customers it is our ambition to set the standards.

So much for the romantic side of hot oil heating. Now, let us explore the competitive aspects.

How long have you needed higher temperatures in your industry? How long have you had machines capable of operating at speeds high enough to require temperatures higher than that available with 125 p.s.i. steam? With 175 p.s.i.? Less than 20 years, I am sure. Now, how many years ago is it that the packaging industry was only half its present size? And, how long do you believe it will be until it doubles again? According to figures I have seen recently it will probably double by 1970.

The same situation could be illustrated in the vast chemical industries, the food industries, and in fact all industries involving synthesis or conversion. Competition has only recently, beginning 20 to 30 years ago, demanded a better process heating system and for higher temperatures.

Thus, we see the demands of recent competition have made the romantic problems worth tackling, and they are now tackled.

Why use oil when it is such an inefficient heat transfer medium? We don't believe there is anything inefficient about it. At least some of the facts we have discovered don't substantiate anything but efficiency. In the first place it is a liquid and at atmospheric pressure it does not, within the ranges used, change phase. Therefore, it can be controlled as accurately as instruments commercially available can sense temperature, and all heat involved is sensible heat, which simplifies control, application, and calculation.

The transport and application pressures are usually a very few pounds per square inch and in the hot oil heater it is heated at atmospheric pressure. Hence, only light gage steel piping and fittings are required.

Installation is very simple. It is as simple as a two-wire direct current electric system and just as flexible. It requires only a line out to process and a line back to the hot oil heater with a mechanism at the point of application to control or regulate it. Any number of processes or machines can be served independently or simultaneously, either manually or automatically. The hot oil heater operates just like a turbine generator in a power station running continuously 24 hr. per day but works only on demand when a circuit is closed; so, the hot oil heater is always maintained at the optimum operating temperature but works only when a circuit is opened in process requiring heat. More about this feature later on.

Maintenance on all process machinery is lower than for any other known heat transfer medium. Mineral oil being inert to the ferrous metals will not corrode or rust. There is no danger of freezing. No expensive treatment machinery is required. No expensive return system is required. No traps are required. No massive and expensive high-pressure equipment is required. Once the system is properly installed that is usually the end of most maintenance troubles and expense.

The temperatures available with oil at 500 to 600°F. a equivalent to those obtainable with steam at 650 to 15 p.s.i. Can you visualize piping, rotary joints, rolls, pr heaters, and hot plates to operate at 600 p.s.i. or higher?

To answer the question regarding the heat transfer c efficient of oil being so low let me state that is only an ac demic question so far as we at the Hot Oil Heater Division a concerned. We believe that impression has developed fro confusing conduction with transfer. We approach all hea ing problems from the viewpoint of the work to be dor and a mechanism to accomplish it. Then, if the mechanis will function and conduction is adequate, the so-called coeff cient of heat transfer is inconsequential. We disregard it an thereby save a vast amount of mental gymnastics and end u with a machine that functions. I could name authors textbooks, engineers, etc. who will disagree with that and must admit that if I could understand their treatises I migh agree with them.

We have explored the practicability of using other currentl popular heat transfer media, including most of the synthetic and we have always arrived at the conclusion the well-refine proper, natural petroleum products are the best all-arou media up to 600°F. at least.

What will the hot oil heater do for you?

It will deliver heat to the machinery in any quantity yo machinery can consume at any temperature required up t 600°F., which is the equivalent of approximately 150 p.s.i. steam, but at a pressure of only a few pounds per squar inch. It will eliminate all high-pressure equipment and mai tenance. It will reduce your heating labor to that require to monitor instruments and for mill wrighting.

What will it cost? Nothing. It will make you mor money.

Initial installation costs are usually equal to or less tha boiler plants. But do not confuse "package boiler units with boiler plants. It will save approximately 90% o your heating and maintenance labor. It will increase you quality and production but how much only you as an operato can tell.

Why the hot oil heater and not some other heater?

In the first place it is thermally stable and it makes n difference whether there is full circulation or no circulatio through the heat exchanger. In case of a power or mechanica failure it will always fail safe. It heats uniformly and ha very little residual heat built up in the unit because so littl refractory is required and the mass ratios of the componen parts and oil are such that the hot oil heater remains in al most perfect thermal equilibrium at all times. It is alway in hydraulic balance at atmospheric pressure and for tha reason any number of processes can be run simultaneously or independently and any number of hot oil heaters can b used fully automatically to serve the same system independ ently or simultaneously. No pressure can be generated o the heat exchanger either by heating or by circulation.

The hot oil heater* is an all-steel heat generator through which a mineral heat transfer oil flows at atmospheric pres sure and is circulated to rolls, mixers, coils, tanks, reactors autoclaves—in fact, to any machinery and equipment re quiring heat in a manufacturing process from 300 to 600°F or slightly higher. It consists of an all-steel heat exchanger, an expansion-seal tank, valves, circulator, fuel burner, an controls. Currently, we offer eleven basic sizes ranging from 300,000 to 30,000,000 B.t.u. per hr. in single units of the fuel-fired type. Indications are that corrugators will require 3,000,000 to 15,000,000 B.t.u. per hr. depending upon size and speed.

In addition to the fuel-fired units we are engineering a series of small electrically heated units for laboratory service etc.

Why is the hot oil heater applicable to corrugators?

* Patents applied for.

R. L. Kreyling, Philadelphia Quartz Co.

L. O. Lundrigan, A. E. Staley Mfg. Co.

Competition demands more production which means higher speed. Higher speed means more heat. But rolls and driers cannot be increased because of the mechanics of corrugating and structural difficulties. Therefore, the only method of getting more heat is to increase the inside temperature of the rolls or driers and to do that with a vapor system requires increased pressures. But by using a heat transfer oil the desired high temperatures can be reached at a very, very low pressure.

How is it applicable to corrugators or driers?

A supply line is run from the heater to the points where heat is required and similarly a return line is run from the points requiring heat—these lines are usually the same size. However, if more than one corrugator or drier is used it is necessary to have only one slightly larger return line even if conditions should require separate supply for each corrugator. At each point to be heated a connection to the supply and return line is made with a mechanism to control the temperature—this may be a simple gate valve, a thermostat valve, another circulator, or a motorized valve of some type. In the case of the hot plates or drying ovens we believe a separate circulator with a proportioning three-way valve should be used to establish the proper heat gradient throughout the hot plate or oven section. In this way whatever temperature is desired at any point of the machine can be obtained and controlled accurately and independently of the rest of the operation. Thus, the heater can be automatically controlled at the highest optimum temperature continuously, and the hot oil controls will maintain that temperature at all times since immediately a circuit is opened and heat is called for, the fuel burner will be piloted accordingly. This is the cheapest possible manner in which to obtain and use process heat within the range here discussed.

What should the temperature be for corrugating? Only you, the operators, can answer that. But the heater will deliver heat to 600°F. whenever or wherever it is needed. 600°F., is equal to the temperature of steam at over 1500 p.s.i.

What effect does heating with oil have on rotary joints? In some other industries the use of hot oil has resulted in better rotary joint life. There are several excellent rotary joints on the market suitable for hot oil service. However, it is only fair to state that if temperatures get too high bearings and rotary joint seals may have to be cooled. But it is safe to say that much higher temperatures can be used safely without appreciable mechanical or structural changes to present machines than are currently being used on vapor systems such as high-pressure steam. As the application of hot oil increases machine design can be simplified and improvements made to utilize to the fullest the advantages of the hot oil system of heating. That is only normal progress and development.

Vapor heating has the disadvantage of disproportionate increase in pressure to increase in temperature, whereas oil heating does not increase in pressure with any amount of temperature increase within the limits here discussed. Therefore, it is not practicable to predict net process heat requirements on corrugators from most steam figures. But we at the Hot Oil Heater Division sincerely believe that with our experience in other fields and the help we have already had from some of the operators in your industry, we are in a position to make safe and conservative determinations of heat requirements for the job you want to do; but it will require cooperation on your part and considerable study and engineering on our part which we are prepared to do.

Thermal Balance with Silicate Adhesives

R. L. KREYLING

HEAT transfer must accomplish three main functions during the combining of corrugated board. These functions are interrelated and require proper controls to assure the results desired. This requires establishment and maintenance of a thermal balance between the main heat applications which follow:

1. A combined steaming-heating at the single facer is required to control the plastic properties and assure proper formation of the medium.
2. The drying of component plies controls the board and is a necessary prelude to subsequent transfer of heat.
3. Sufficient heat must eventually be transferred during each operation to provide the B.t.u. needed for set. This heat must pass through the intervening components to their far side whose surface and fibers retain the adhesive.

The steaming and heating of the medium must be adequate regardless of other operations. It may therefore be supplied entirely separately or as primary use for high-pressure steam which is then recovered for subsequent reuse. Although the former's advantages are just becoming recognized, both systems affect the two sides of the combination equally and warrant disregarding their influence here.

The roll stock is generally controlled today through use of large, variable wrap preheating rolls. This drying heat requirement of the board components is subject therefore to direct manual control and can be made automatic as conditions justify the instrumentation expense involved. This thermal application can therefore be kept in balance as necessary and only justifies minor consideration as it affects the following main problem.

Transfer of heat to set the adhesive is at best a difficult task—steam must heat metal which transfers through any air or other films through the board to the adhesive. No wonder that heavy or damp stocks restrict speeds which are directly related to rate of heat transfer. The troublesome stocks present added mass and drying needs including the tremendous latent demands to overcome heat of vaporization and occasional ice crystallization. The magnitude of this heat problem cannot be overemphasized and has too long proved a "bottleneck" that must be broken.

With board conditioning properly controlled separately at the preheaters, let us now consider the real culprit—the heat required to set the adhesive. The single-facing adhesive problem is quite different from that of double backing. Proper supervision of adhesive applications is essential and must maintain a uniform, economical, but adequate spread across the machine at both stations. The expense for establishing and maintaining such controlled clearances will be recovered many times over and promptly through actual material savings and product improvement.

Six pounds silicate per 1000 sq. ft. is enough to combine the single-faced web effectively, it adds about 3.6 lb. water to the combination but only requires loss of 0.9 lb. water for initial set. Heat transfer under the extreme pressure between rolls is adequate and assured even though contact is limited to

R. L. KREYLING, Philadelphia Quartz Co., Philadelphia, Pa.

only one to three flutes—about $^1/_{100}$ to $^1/_{50}$ sec. at 350 to 500 f.p.m. speeds. The real problem during such short-time intervals is controlling adhesive penetration and its attending moisture. The preheated liner probably contains 7% moisture or less, but the combined web usually shows 10 to 12% moisture on the bridge due to absorption of both adhesive water and shower steam. The preheated web enters the double-facing glue station again reduced but then is practically saturated during passage over the plates with steam driven from the lower combination. At the take-off, this top liner normally contains 10 to 15% moisture and frequently runs even higher. Suffice to say, this top ply has had a wide variation in moisture content and little chance for close control.

Nine pounds or more silicate will combine each 1000 sq. ft. board at the double backer, introducing 5.4 lb. water but only requiring loss $1^1/_3$ lb. for good set. Heat transferred to this ply during the $5^1/_2$ to 9-sec. travel over the 44-ft. oven section maintained at temperatures of 320 to 375°F. at 300 to 480 f.p.m. actually dries the combined 42-lb. or lighter liners down to $3^1/_2$ to 7% moisture but requires longer time provided by reducing speeds for similar heat transfer with heavier or damp boards. Of course, the evaporated moisture passes through the combination just ahead of the heat to saturate the top plies as previously indicated. During the $5^1/_2$ to 9-sec. passage over the curing section, this dried bottom liner readily reabsorbs some of the retained vapors but shows only 7 to 9% moisture content at the take-off.

With this "green" combination containing 10 to 15% and more moisture in the top plies and only 7 to 9% in the bottom, an unbalanced condition exists that often results in excessive shrinkage of the top during seasoning and a corresponding tendency to curl or warp in that direction. If speeds were curtailed by other factors, such as short orders, poor rolls, machine adjustments, etc., the single-faced bond would probably continue relatively satisfactory due to assured penetration under pressure but the double-faced bond would likely be baked during the longer periods on the ovens to become weak and brittle. Such overheating is a major cause of "dusting," together with high-low corrugations, smeared patterns, spray between flutes, etc. All these conditions are unnecessary and should be corrected.

For too long, need for high heat transfer has necessitated maintenance of high surface temperatures with the attending problems of (1) slow speeds on heavy damp boards, (2) periodic brittle bonds, (3) unbalanced moisture distribution, and (4) dimensional problems with curing stock.

There are solutions to this high heat transfer problem:

1. We reduce the adhesive moisture content to a practical minimum through addition of solid clay to liquid silicate.
2. Preheating this mixture before supplying the pan directly reduces the heat requirement 20 to 35% by providing a partial "flash" set.
3. A desiccating agent, such as starch, proteins, etc., is added that is activated at moderate temperatures and swells by absorbing moisture from the silicate to directly reduce need for evaporation and to control set so good bonds are assured at top speeds with wide variations in board weights, moisture contents, etc., since heat transfer needs are minor.

With this substantial reduction in heat transfer requirement and its attending problems, the question is how best to reduce and control the heat applied. If a new combiner were being installed, the hot plate sections could be reduced 25 to 50% and the curing section limited to the length assuring traction. Established units assure high rates of heat transfer through high pressure steam supply and drainage systems. If continued, they set these preheated mixtures too quickly and preclude the proper wetting and penetration of the fibers necessary to consistently good bonds. Careful control of preheaters and reduced pressures for the plates are steps in the right direction. Shutting off entire sections of plates is tempting but is undesirable because cold metal surfaces accumulate condensate which results in dragging, scuffing, and occasionally pealing of the liners.

As an alternative, continue full control of preheaters, then supply the first section of 6 to 10-ft. plates with only 10 or 20 p.s.i. steam through a simple reducing valve and supply controlled pressures to the other plates as necessary. This prevents condensation on the first section plates and provides pressure enough to return condensate trapped from that section through the heater system low-pressure return line or drain to the sewer. A few experiences with such systems confirm that the low-heat-requiring adhesive, our "three-way" process, adequately wets and penetrates the fibers during this longer "wetting" period and then sets quickly with rapid heat transfer during passage over the other plates.

Penetration was no problem years past when slack-sized jute and straw permitted good silicate anchorage during the 1 to 2 sec. travel at 225 f.p.m. or lower speeds over the 4 ft. from the glue rolls to the first plate. Today, only $^1/_2$ to $^2/_3$ sec. travel covers this same space at 300 to 480 f.p.m. speeds and the natural sized krafts, semichemical mediums, and other stocks present real resistance to wetting. So give the adhesive a chance. Remember it takes 30 min. and longer per pound to cook a raw ham, but only 5 to 10 min. per pound for a precooked ham—fact is longer cooking destroys the texture and flavor to make a precooked ham tasteless.

Last but not least, it requires only $^1/_2$ to 1 lb. steam to preheat the 15 lb. of silicate adhesive used in combining a 1000 sq. ft. double-faced board but 15 to 25 lb. steam are used in heating the regular 123-lb. board enough to transfer the equivalent heat to this same 15-lb. adhesive beyond the facings. If you still pour 15 to 25 lb. steam into the board after preheating the adhesive, you will "bake" the combination, preset the adhesive into a plain coating, and probably embrittle the board itself. So set up a balance and control the heat transfer to only satisfy actual needs. This permits consistent production of well-bonded, rigidly formed, flat sheets and boxes that can "take it."

The Role of the Steam System in Corrugating

PAUL HARRISON

THE corrugating industry has come a long way since the days when one "spit on a preheater" and observed the bounce to determine if it was "up to heat."

In 1943 special heat studies based on newly developed techniques for studying the corrugator operation made it possible to fairly definitely point out the limitations which were holding back progress, and to predict today's higher corrugating speeds.

It is probably not too much in error to say that every corrugating machine made during the period 1943 to 1953, inclusive, was obsolescent when the order was signed.

The questions, then, it seems to me, are:

1. Was it really necessary for the corrugating industry to have to wait 10 years to get the kind of equipment which only now is becoming available?
2. What can you do to shorten the lag between research, development, and proved performance?
3. If you do your part, along with others who stand to benefit, what kind of equipment could be built today?
4. What really determines the obsolescence of a combiner—or what is a true measure of corrugating performance?

It is not my intent here to answer all of these questions in detail, but I do want to pass on some ideas which may be helpful to you in giving direction to your thinking—ideas which may stimulate you to bring forth the follow-up that appears to be called for, and to show you how you can use your steam system as the one reference position in the com-

PAUL HARRISON, President, Velocity Steam Production Engineering, Inc.

bining operation from which you can confidently proceed to deal with the problems that must be dealt with in answering these questions.

Was it really necessary for the corrugating industry to have to wait 10 years to get the kind of equipment which only now is becoming available? I don't think so.

If in 1943 a group had been working together as effectively as you are today, together you could have researched as a coordinated group—spelling out your requirements, standards of performance, etc., and passing on to your manufacturers the data upon which their design work must rest. You are the losers if you saddle your manufacturers with the full burden of keeping in close step with progress. . .your manufacturers cannot be expected to do the job as fast alone as if you were funneling vital information to them as fast as your coordinated group efforts prove it effective.

As a group you can spell out what constitutes good corrugating performance—present and future—relative to given heat exposures, etc. You can categorize and classify the limitations which prevent realization of such performance, and set forth the possible remedies in their most logical order. . . working closely with your manufacturers and encouraging them in every way possible. Knowing what your equipment should do and what it does—what corrective measures are called for. . . what new equipment will do, and what probable future improvements are to be expected, as well as their probable rate of development—then, and only then, can you satisfactorily arrive at a decision as to whether you should revitalize your present equipment at a relatively modest cost, by new equipment because of its merit, or justify waiting for further developments which may be effective in only a short while.

Before we are through, I believe you will feel as I do that new equipment should be capable of running between 800 and 1000 f.p.m., and that provision should be made for handling larger roll stock and for one-way stacking off the take-away.

When you have spelled out, in their most logical order, the probable remedies for various present limitations now holding back your production, it is my experience that you will see how to run your present corrugating equipment at from 50 to as much as 200 f.p.m. more than you are realizing at present, while having board as tough or tougher than at present and with less waste.

Now just where in this picture do we come upon the role of the steam system in corrugating? I suggest that we recognize and make the most of the fact that your steam system can make it possible for you to evaluate and adjust machine performance more effectively for highest efficiency if you will do so relative to the heat actually packed into the board components. Many of you will recall my prediction in 1943 that much of the combining equipment then in use had a potential of 450 to 500 f.p.m. This prediction was developed from heat studies premised on a high, continuously constant rate of heat transmission which was, and probably still is, the only reliable constant in the entire corrugating operation. For a given steam pressure and heating surface it was possible to determine the approximate heat charge which should have been received at various critical points in the operation and, therefore, to know the approximate maximum speeds at which quality production ought to result.

At this point I should like to make note of the fact that it was the evaluation of the structural capabilities of the equipment to run at these speeds, made by Robert Cassady of the Jackson Box Co., that encouraged me to make this prediction.

These studies laid bare the ghastly price being paid for the wide tolerances in the cooperation of heated mechanical parts: tolerances which may have been largely unavoidable due to widely varying steam conditions and the consequent possible heat distortion of the corrugating and pressure rolls. The design objectives prior to 1943 appear to have been largely sturdy parts, and as much distance as possible between the heated cooperating parts, possibly to keep away from trouble due to unpredictable heat distortions. That loosely cooperating parts and their consequent low heat flow and problems of formation are limiting factors in production, stands out as a fact expensively borne out by high production cost, low quality, customer complaints, and excessive waste, a fact which 10 years ago became readily apparent in the searching examination of penetrating heat studies.

You know that one poor link can weaken a whole chain. Since steam conditions vary so widely from plant to plant, designers have found it difficult to arrive at any true reference point for closely judging the performance of their machines. If all plants had a high continuously dependable heat level, all plants could benefit in the improved machinery which could be designed for them.

To give you an example of how widely steam conditions can vary and for a further appreciation of what we mean when we say that there can be as much difference in steam as there is between life and sleeping sickness, take the plant which in 1942 held the top corrugating production record. This plant operated at about 350 f.p.m. at 160 p.s.i. At this same speed, and with steam out of the same boiler, equivalent board temperatures were realized with only 85 to 90 p.s.i.; regular operating pressure was set at around 115 p.s.i. to take care of varying moisture content. The additional heat held in reserve, 115 to 160 p.s.i., could not be fully utilized due to physical as well as mechanical limitations which later were corrected to permit 500 f.p.m. operation.

Another plant modernized its steam system and was able to run 0.030 single and double wall—widest widths—at 300 f.p.m. with only 120 to 125 p.s.i., having only 28 in. of preheater contact at the single facer and a 30-ft. section of hot plates. (These speeds were maintained with board taken from a car in $-40°$ weather.) Before modernization, this plant combined such board at speeds of about 110 to 115 f.p.m. at 145 p.s.i. (As an interesting side observation—the boiler at this plant, by conventional measurements, was judged to be too small, and after changing from coal to oil it could maintain only about 125 p.s.i., compared to its former 145 p.s.i. Yet, in later years, this plant has increased its rate of production by as much as 50%, has added another single facer and a coating machine, and the same boiler still is carrying the load satisfactorily. Steam engineers say this boiler is not supposed to generate so much steam, but the performance speaks for itself.)

These cases are related here to emphasize the importance of the role of the steam system in corrugating, the extra profit that can be added to, or taken away from, your operation, and to emphasize also that, in relation to production heating with steam, the past has had no really dependable standards to work from; that, as a result, machine design has suffered, and that the standards which were being used for a guide have been "knocked into a cocked hat."

While a large number of plant operators are personally acquainted with the advantages of today's maximum steam efficiency for production heating, many in the industry have lost sight of the basic improvement which has been made in the handling of steam. This oversight, I think, has been due to the additional heat which they have enjoyed through adding more heating surface in the form of more and larger preheaters. As a result, their progress has been somewhat circular—hemmed in by the basic limitations, or variables, inherent in their steam systems.

The larger preheaters are indeed a blessing. But even more so is the additional heat that can be obtained in your corrugating rolls, pressure rolls, and your first plate section by more efficient application of your steam. And perhaps even more important than "more heat" is heat that is dependable—the same hour-in and hour-out around the clock, because constant heat can be your key to the lowest cost operation at your plant's most vital point of production.

The plant which effected such spectacular results with

their 1936 corrugator (achieving sustained speeds of 510 f.p.m.) kept their eyes on the basic improvements that were called for, and one by one they tracked down and overcame the limitations which unnecessarily were holding down the speed of their equipment. As a reference point for this accomplishment, they worked from a high, continuously dependable rate of heat transfer, which again proved its value when, in 1953, they came to evaluating the performance of their new combiner, operating at 600 f.p.m.

The chief engineer of the company supplying this machine had finished his check and one of the machinery company's top installation men had finished his main work. The board from this machine was good, even excellent. Tests showed the board to be well up in the desired range and by all standard checks there was nothing more to be done. Everyone concerned was starting to relax over a job well done, when heat studies indicated that one side of the machine was not performing as well as it might, and searching tests of the board bore out this observation.

Probably the operation never would have been handicapped by this fault as long as it remained in its present range of slightly over 600 f.p.m. However, lack of further adjustment would have made it impossible for this plant to realize the 800 f.p.m. which someday they may find it worth while to try for, and which I feel confident they can realize, and with heat to spare.

The equipment referred to is really fine, a splendid combiner. I have related this incident only to further emphasize the value of having every possible check in helping you to fully realize all that your machine has to offer, and the real help that high, continuously dependable heat transmission can be to manufacturers in the design of their equipment.

I might also add that in a special test, board from this equipment exceeded test requirements when run with steam pressures as low as 85 to 90 p.s.i. at 530 f.p.m., not that anyone is recommending operation at these pressures, this is just a hint that higher steam pressures are not necessarily the complete answer. . . it is still important to be sure that every pound of steam works as hard as it can.

Quality production at high speeds, in my opinion, is not being held back by lack of heat. The heat is available—all that is needed is to apply it efficiently. The heat treatment of corrugated board has developed far beyond the mechanical limitations of the process. What is needed is definition and removal of the mechanical faults, and the fastest, the surest, and the most economical approach I know in overcoming such limitations is through heat studies.

But just one more thing. It is my understanding that the machinery manufacturers share with you your concern over today's high costs of combining equipment, and that one of the offsetting economies sometimes suggested is in the kind of a steam system offered as standard equipment. I wonder if any system less than the best is really a saving, or even wise, either for the manufacturer or for yourselves.

As to any economy in failing to realize all of the value that can be found in the best possible use of steam; ask the plant operator who has had more than his share of highs and lows due to design deficiencies; ask the plant operator who has a 1950 combiner and, reportedly,* is limited to about 280 f.p.m. when running 42-lb. liners, wide widths; ask the plant operator with a fairly new combiner who already has had its plates warp as a result of water-logging (and if plates warp, what about corrugating rolls?); or ask at the plant where they aimed at record high-speed production via a new combiner and a new high-pressure boiler installation only to find, after installation, that while the combiner was built like a battleship, the thick metal walls of the steam vessels reduced the delivered temperature to the same levels as realized with the old combiner operating on low-pressure steam. All of these plants, I feel sure, knowingly can say that it is not economy to have less than the best steam system you can get, that it is not the initial cost of a steam system which should concern you, it is the cost of poor machine performance throughout the life of the equipment that can really hurt.

Probably none of us can honestly call himself a steam expert—there is still a lot about steam and production heating that hasn't reached the textbooks—and very probably still more that isn't even known yet. But since maximum steam efficiency is so vital to your operation, perhaps it will be helpful if we very quickly and simply review some of the problems which must be faced in deciding how you may best apply steam to your corrugator.

EFFECT OF HEAT LEVELS ON CORRUGATING EFFICIENCY

Processing corrugated board on a combiner is just like boiling water on a stove. You don't have good board until the moisture in it has been boiled or "evaporated." Since a definite number of heat units (B.t.u.'s) is necessary to evaporate a given quantity of moisture, it necessarily follows that the more heat units being transferred to the board, the faster the board can be combined and the better its quality will be. If the heat can't get there, good management, good supervision, labor incentives, and the most modern equipment *cannot* produce.

You wouldn't expect to boil water quickly through an asbestos "simmer" pad. Less heat gets through the asbestos and it takes much longer to boil the water. The resistance of the asbestos retards the flow of heat, or lowers the heat level. Heat level is the rate at which heat (or heat units) gets from the steam in the steam vessel to the board being dried in the combiner. The faster the heat flows, the higher the heat level.

To show you the importance of faster heat flow, almost obsolete combiners with high heat levels can outproduce modern equipment with low levels, and there are cases on record that prove this. The most outstanding is the 1936 corrugator which was "souped up" to run at 510 f.p.m. But there is a case of a really antique corrugator which ran 0.016 board at 285 f.p.m. with only 40 p.s.i., minimum preheater contact, and just 24 ft. of hot plates.

Heat Level Limits

Every combiner has three factors which limit the heat level:

1. *Limited Contact Heating Surface.* Let's go back to the stove for a minute and put a large washtub full of water on it. It won't take the water as long to boil if you light all the burners than if you light only one, because you have increased the "heating surface."

Larger preheaters and corrugating rolls increase heating surface, and higher steam pressure is like increasing the "flame"; but all of this is only a start.

2. *Vessel Walls.* The walls of your rolls and hot plates are like the metal pot in which you are trying to boil the water. They may have the best heat-flow characteristics the manufacturer can put into them, but they still offer some resistance to the transfer of heat units.

3. *Air and Water Films.* As steam reaches the heating surfaces of your combiner, it unloads air particles along with heat units. The air particles try to travel down, and the heat units try to get up to the work being dried. The result is a "traffic jam," a film of gas and air particles. Also, the condensate which forms as the steam cools clings to the rough, pitted surface of the condenser and forms a water film.

These are the real sources of trouble, comparatively speaking. They hold back as much heat as the asbestos pad on the stove. Few people know that condensate holds back heat 60 times as effectively as metal walls. And even more amazing is the fact that air and gases have 1500 times the heat resistance of metal walls.

* See "Corrugator Survey," a TAPPI study reported by H. T. Scordas, November, 1952.

A 1-ft. thick jacket of cast iron wrapped around the outside of your hot plates or rolls will give the heat-resisting effect that you have from a film of water only $^1/_5$ in. thick, or from a gas film less than $^1/_{100}$ in. thick.

Many people think that the solid metal walls of the steam vessels offer the greatest resistance, but this is not true. Experiments have shown that gas and water films alone can account for as much as 90% of this triple resistance, with the metal vessel wall accounting for only about 10%.

For every heat unit that reaches your work at a given instant, 10 are being held back by the combined resistance of the air film, water film, and metal vessel wall. This means that heat flow could increase as much as 1000% if both the gas and water films could be completely eliminated.

Steam must condense to give up heat. Because air and water are a natural part of steam heat, steam has within itself the very factors that shackle its own usefulness. It carries its own insulation to form barriers against its own heat.

For every 20 lb. of steam condensed in the steam vessel, 1 cu. ft. of air will be released when the boiler feedwater is not deaerated. Although deaerators and other means of removing air from water help to reduce the quality of residual gases, your steam is never free from them. And we have seen that a minute quantity of residual gas released in a steam vessel regardless of deaeration can hold back heat flow as much as 50%.

Many attempts have been made to remedy these causes of slow heating, but over the years improved steam traps and other devices have done little to lift production heating beyond the horse-and-buggy stage of development.

Once these films are formed a steam trap cannot remove them. All that a trap can do is to wait passively for whatever condensate and gases drain out of the steam chest. This gravity flow is sluggish and cannot attack the resisting films.

Neither is it practical to consider pumps because the elasticity of steam in a system keeps pump action from reaching back into the equipment.

For maximum efficiency, the air and water films must be broken up and swept out, as fast as they form, so that heat can drive right through to the metal walls. But no passive measure can disrupt these two resistances; and there are no mechanical means capable of getting into every vessel to drive out automatically these shackling barriers, barriers which can cost you from 30 to 50% of the full capacity of your combiner, barriers which add up to costly overhead.

Whether your business stays competitive at a profit may actually depend on the difference between getting all the production that is possible from your combining equipment—and getting less than full production with low heat levels. And while it is true that "steam is steam," there can be as much difference in the quantity of heat delivered from plant to plant (or from hour to hour in the same plant) as there is between life and sleeping sickness.

Comparatively recent studies in the transmission of heat from steam have shown that steam, given the freedom it needs, has within itself the power to break up and reduce its own air and water films.

By using a fraction of the system's steam for power, steam can be made to smash these heat-resistant films and release the heat which is necessary for faster drying and more production, heat which is otherwise unavailable.

This power action is generated through the natural actions of steam: (1) steam and condensate flow from a higher to a lower pressure, (2) steam flow increases when pressure drops, and (3) when pressure drops, a fraction of condensate flashes back into steam.

The effectiveness of the action produced depends on the kind of steam flow you have.

KINDS OF STEAM FLOW

Replacement Flow, as in trap operation. The vessel can hold only a fixed volume of steam. Steam flows into the chest only as steam in the chest condenses and condensate drains off. This gravity flow is sluggish and cannot attack the resisting films. It is this type of operation which permits the heaviest build-up of air and water films.

Steady Velocity Flow. Steam flowing through at faster than replacement flow slices off some of the films. This slicing action is limited because it is not efficient to operate continuously at velocities which are high enough to sweep off all of the film areas.

Pulsating Velocity Flow. This is velocity flow plus pressure pulsations. When pressure drops, liquid surfaces vaporize back into steam with an explosive action. In a steam vessel, liquid surfaces are provided by the numerous dispersing water particles together with the condensate film. When pressure drops, these water particles vaporize in the manner of minute explosions, expanding 24,000% with a turbulent and disruptive effect on the air film and the adjacent condensate film. In addition, there is a further reduction of the total resistance as a result of the thinning of the condensate film by simultaneous flashing.

These pressure pulsations are regulated to provide short, powerful surges of steam to create high peak velocities which actually dig into the air and water films and constantly sweep them out of the vessel. As a result of this continual digging, blasting, and sweeping-out of the heat-resistant films, heat units can reach the surface of the vessel more easily. Because more heat units are passing through the surface of the vessel into the work, production can be faster, turning out tough, high quality board.

STEAM PRESSURE

Another effect of the reduction of air and water films is that steam pressures need not be as high as usually specified. The air and water films are like a wall through which the heat units must pass in order to get to the work. When the "wall" is thinner, less pressure is needed. Because velocity steam reduces these films, corrugator operation at high speeds is possible with less than 150 p.s.i., and there are on record several instances of over 300 to 350 f.p.m. operation at less than 100 p.s.i.

When velocity steam is compared with more passive methods of handling steam it is expected that results at least equivalent to those of passive measures can be realized with 30% less steam pressure, and in applications where wet sheeting is processed, it is not unusual for velocity steam to guarantee 25% more drying capacity with 30% less steam pressure.

INCREASING THE HEAT LEVEL

It is the tremendous magnitude of the handicaps presented by the air and water films that holds the most promising possibilities for increasing heat levels. Since completely eliminating these films would increase heat flow as much as 1000%, it is easy to see how just reducing these films can raise heat levels sufficiently to increase the capacities of some corrugators by as much as 50%. This has made it possible for many corrugators to run the widest widths as easily as the narrow and there are records of corrugators running 0.030 double wall, wide widths, at 300 f.p.m.

To further appreciate this principle of activated steam, try stirring the next iced drink that's put into your hand, the drink gets cold faster, doesn't it?, just as your board gets hot faster when you make it possible for steam to "stir" itself and break up the heat-resisting water and air films on the inside heating surfaces.

Draw a glass of water from the tap, let it come to room temperature and observe the air bubbles that collect on the side of the glass. . . and remember, as you observe the air that collects, that a film of air less than 0.01 in. thick in your rolls and hot plates is approximately the same in heat resistance as if you were to increase the thickness of the metal walls by 1 ft.!

And remember, too that for every 20 lb. of steam condensed in the steam vessel, 1 cu. ft. of air will be released when the boiler feedwater is not deaerated!

As Mr. Cassidy pointed out in one meeting, and as has been borne out in the data presented here, deaeration of boiler feedwater is your first step to steam system efficiency. Then comes activation of your steam with consequent breaking up and removal of the air and the condensate films just as fast as formed, and forced return at a rate equal to the flow of steam into your corrugator. When this force return is triggered by a depressed boiler water level, you can be sure that the return flow will be synchronized with steam input, on a pound-for-pound basis. This ties automatic system-wide velocity regulation to your heat load in the most effective way possible and establishes a continuously dependable heat base from which you can systematically explore corrugating variables that otherwise are almost impossible to get at.

I believe it may be more to your interest here if I pass over the various ways that these variables can be approached, in order to get to that $64 question: "How can you know that you are not supplying too little heat to the board at the right place or, conversely, that you are not driving too much heat into the board at the wrong place?" for, in short, this is the key to the ultimate control of warpage.

Q.: In the CB system where does the steam come from for the shower? Is it wet or dry steam?

Mr. Lundrigan: Normally, as indicated on the drawing (Fig. 2) steam for the shower is taken from the main steam supply line. As saturated steam should be used in a corrugator for best results, the steam would be of consistently good quality for this purpose. It is our opinion that flash steam will vary in quality and, hence, contribute to the necessity for irregular volume control by the operator. If steam for this purpose is taken from the condensate return piping system it will lower the high-temperature return of the condensate to the boiler, adding to the total steam cost, with no particular benefit experienced.

Q.: How is the steam system vented in the Cochrane system?

Mr. Lundrigan: The Cochrane system is completely "closed" with the steam from the boiler flowing through the corrugator and the condensate from the corrugator back to the CB unit which discharges it into the boiler normally at a temperature within 7 to 10° of the pressure utilized on the corrugator. There is no need to vent flash steam from this system, but the unit does automatically eject all entrained air and gases from the circuit without actual flash loss.

Q.: How would you correct a condition where bond is excellent right off the combiner but becomes poor on standing?

Mr. Vander Meulen: I have never seen a condition as described. It sounds as if the starch might have been overheated. It may have had enough moisture in it as the board comes off the machine to give the appearance of a good bond but then the starch crystallizes as the board is conditioned in the load, thus resulting in a poor bond. I suggest trying reducing the temperature of the hot plates, especially toward the end of the hot plate section, using steam pressures down to 90 lb. or as low as 50 lb. in the last hot plate section.

Q.: What instrumentation and procedures do you recommend for a box shop to measure the efficiency of its heating system?

Mr. Nitchie: The most important check is frequent (daily if possible) temperature checks of the various steam-heated elements on the machine with a portable pyrometer. These readings should, if possible, be taken in the same way by the same man, and should be regarded only as relative. The reason for this is that the readings can fluctuate widely, particularly on moving surfaces due to the development of frictional heat which may vary with pressure on the element. They are valuable, however, in spotting an abrupt change which may indicate a defective siphon pipe, or a bad trap.

It is also important to have accurate gages on the input and return headers of the single facers, in order to maintain an adequate pressure drop of 5 to 7 lb. across the rolls to insure adequate siphoning. The best arrangement is probably to have one gage interconnected to both headers with suitable valving so that both pressures may be read on the same gage. A thermometer in the main steam line is also a good thing to have to spot a superheat condition. All plants should, of course, have a recording flowmeter in the main line to the corrugator to aid in allocating steam cost and spot unusual demand trends.

Q.: How many pounds of steam do you require for 1000 sq. ft. of board?

Mr. Nitchie: This will vary widely, depending upon such things as moisture content of medium and liners, whether the liner has been stored outdoors in cold weather, quality of steam, etc. If, however, we assume board of normal moisture content stored indoors and dry saturated steam, I would say that a reasonable expectancy would be 30 to 35 lb. of steam per 1000 sq. ft. of board.

Q.: How should proper mixture at the shower of live and flash steam be best maintained—automatically or manually as operating conditions change?

Mr. Nitchie: The normal procedure is to use as much vent steam as possible, bleeding in live steam only when the vent steam supply is inadequate to meet the shower demand. This is usually done manually, however a pressure regulator piloted from the shower line and controlling the live steam supply may be used.

Q.: How many installations of hot oil on corrugators do you now have and what economies over the systems previously used on these machines have been attained?

Mr. Swaney: I know of three or four installations that have been tried, one of them has been very successful, one of them has very definitely proved the merits of the system although in the particular instance they are using one of the synthetic oils instead of a mineral oil such as we use and they have been having some problems. The other two had considerable trouble due to the type of unit in which the oil was being heated which, of course, is our claim to fame. We claim that we have the most successful generator for generating heat in the mineral oil to be used in process.

Q.: Will we have to increase our pipe sizes to convey as much heat to our rolls and plates as we now do with steam?

Mr. Swaney: I believe that we can safely answer that question "no." On the basis of the information given us and our experience in other industries, it is our belief that sufficient heat can be delivered to a corrugator roll using the conventional 2-in. roll journal openings. I am sure there would be no trouble whatever if it were piped in one end of the roll and out of the other. However, there is still an excellent chance that using the supply and return in the same journal end of the roll with a 2-in. hole, will not only provide enough but much more heat than can be obtained with steam at the present time. However, this will not be known until more experience is gained and actual figures are available.

Q.: What is a budget figure for a 5,000,000 B.t.u. per hr. unit and piping to one single facer?

Mr. Swaney: A budget figure for a 5,000,000 B.t.u. per hr unit, which would be known as a Model 636, would be approximately $30,000 plus installation and insulation. However, to that must be added whatever instrumentation and particular controls that might be required for the process. A total outside figure of a Model 636 Hot Oil Heater installed on the average corrugator, would be $40,000 to $50,000, depending upon the amount of instrumentation and further controlling that might be required.

Q.: Can you point to any existing corrugating installations in successful operation?

Mr. Swaney: Yes, there has been at least one highly successful installation using oil as a heating medium on a corrugator. This is on a single facer only. No preheaters are heated with the oil to my knowledge. There is also another installation in which one of the synthetic oils is used instead of a mineral oil such as is used in our units. This latter unit, I understand, also is used to heat one or two sections of the hot plates. I consider the unit a successful operation because it is demonstrating without question what we claim to be an advantage when heating with hot oil.

General Session

The General Session was the last of the four sessions sponsored by the corrugating group. John Fuko of the River Raisin Paper Co., Monroe, Mich., acted as chairman.

TAPPI Corrugating Waste Survey

F. D. LONG

WASTE in a corrugated box shop is one of the most costly aspects of corrugated box manufacture. Unfortunately, we tend to consider it as an inherent and uncontrollable factor all too frequently. The waste committee has attempted to highlight the magnitude of the problem through an industry survey.

The Steering Committee had to agree on waste terms and definitions before approaching corrugated firms in the waste survey. The recommended terms were submitted in the

F. D. LONG, Container Corp. of America, Chicago, Ill.

survey, asking for an expression of approval or rejection. The survey on waste covered the month of September, 1953.

The voting on waste terms resulted as follows: 29 firms affirmative and 3 firms negative. One of the latter voted on the terms but did not submit data. Some of the firms gave constructive criticism of our approach which were included in a revised set of terms which are submitted here.

Gross Waste—All waste arising in the plant that is baled (disposed of or re-used) expressed as a percentage figure to the roll stock consumed (exclusive of all raw materials such as adhesive, tape, etc.).

Net Waste—Gross waste minus noncontrollable waste expressed as the percentage of controllable waste to roll stock consumed.

Noncontrollable Waste—All waste not subject to reduction by careful manufacturing methods; this category includes customer waste, dunnage, and railroad damage.

Customer Waste—All waste inherent to and characteristic of the item made; all waste arising from the basic blank sheet except slitter or press end trim, including flap cuts, slots, stitch lap cuts, die cuts, corner cuts, etc.

Dunnage—Extraneous waste arising from sources other than rollstock, such as car liners, roll cores, starch bags, tape and wire boxes, miscellaneous, etc.

Railroad Damage—All waste arising from roll stock damaged prior to receipt in the plant. The intransit damage for which a claim was made and allowed.

Controllable Waste—Same as net waste; that waste which can be minimized by careful operating practices.

Combining Waste—All controllable waste collected at or attributable to the corrugator; all single-facer waste except dunnage and railroad damage and all cut-off waste including side trim, splices, loose paper, reject sheets, and sheets rejected in later fabricating steps attributable to combining.

Fabricating Waste—Sometimes called box shop waste; all waste, except customer waste and dunnage, arising between the combiner and the shipping room. Rejects attributable to combining errors are charged back to combiner waste.

There is always a conflict on terms which honestly reflect the opinion and experience of the firms involved. However, in order for progress to be made, some compromises are necessary. For surveys such as this, covering a short period of time, you usually have to use breakdowns that vary from normal practice in handling waste. The most difficult problem lies in analyzing corrugator and press trim where both are handled with a common blower system. In such instances, the simplest procedure is to set up a random sampling procedure at both operations for the check period. As a matter of cost control, this is highly desirable at all times, since either operation can get out of line and you do not have proof as to which operation is the culprit.

The waste data requested from each participant were as follows:

1. Consumption in pounds.
2. Baled waste in pounds.
3. Gross waste in percentage.
4. Net waste in percentage.
5. Combining waste in percentage.
6. Fabricating waste in percentage.

The committee realizes that to control waste requires a more detailed analysis than this simplified breakdown. Due to diversity of plant layouts, type of equipment, business and

Table I

	Pounds consumption in millions					
	1–2	*2–3*	*3–4*	*4–5*	*5–6*	*6–7*
			Pounds Baled Waste			
1	185,686 (58)	167,074 (49)	275,531 (65)	353,625 (26)	554,205 (47)	665,820 (43)
2	189,555 (2)	202,932 (66)	284,195 (15)	441,812 (31)	554,403 (20)	689,965 (42)
3	192,236 (40)	235,765 (39)	322,073 (30)	475,760 (34)	574,566 (11)	1,042,136 (1)
4		251,329 (4)	342,304 (60)	478,360 (59)	574,985 (35)	
5		251,725 (41)	350,185 (17)	528,029 (24)	605,180 (51)	
6		252,042 (3)	383,940 (10)	562,680 (45)	637,581 (62)	
7		255,508 (38)	430,995 (23)	695,187 (16)	677,940 (8)	
8		262,248 (64)	434,145 (25)		699,193 (22)	
9		269,205 (57)	479,025 (44)		758,210 (52)	
10		274,675 (21)	696,393 (32)			
11		280,298 (33)				
12		283,335 (37)				
13		288,344 (36)				
14		318,110 (27)				
15		319,470 (18)				
16		337,845 (56)				
17		343,375 (61)				
18		346,695 (29)				

	Pounds consumption in millions					
	7–8	*8–9*	*9–10*	*10–11*	*11–12*	*12–13*
			Pounds Baled Waste			
1	592,530 (14)	725,365 (48)	927,675 (54)	1,116,625 (5)	1,420,876 (12)	1,385,805 (6)
2	642,147 (63)	976,080 (53)	1,150,800 (50)	1,427,200 (46)		
3	679,500 (7)	1,064,027 (28)				
4	819,750 (13)					
5	881,196 (55)					
6	1,002,000 (9)					
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						

Table II

	Pounds consumption in millions											
	1–2	*2–3*	*3–4*	*4–5*	*5–6*	*6–7*	*7–8*	*8–9*	*9–10*	*10–11*	*11–12*	*12–13*
					Percentage Net Waste							
1	16.1 (58)	4.3 (49)	5.3 (65)	7.3 (26)	6.6 (20)	5.6 (42)	5.0 (63)	7.4 (55)	9.4 (54)	10.9 (46)	8.1 (12)	8.8 (6)
			7.3 (31)									
2		5.3 (3)	5.6 (15)	7.5 (59)	6.9 (8)	13.0 (1)	6.0 (14)	7.5 (48)	10 9 (50)			
3		5.9 (64)	7.8 (23)	7.9 (24)	8.2 (51)		7.2 (7)	9.4 (28)				
			7.8 (60)		8 2 (62)							
4		6.6 (57)	8.0 (30)	9.4 (34)	8.4 (47)		8.2 (55)					
5		6.7 (66)	8.4 (32)	9.9 (45)	8 7 (22)		8.6 (13)					
					8 7 (35)							
6		7.3 (29)	8.8 (25)	13.2 (16)	9.5 (11)		8.9 (9)					
7		8.1 (27)	8.9 (17)		10.7 (52)							
8		8.2 (4)	10.2 (44)									
9		8.4 (56)										
10		8.6 (61)										
11		8.9 (36)										
12		9.8 (37)										
13		10.5 (33)										
					Percentage Gross Waste							
1	10.1 (2)	7.5 (49)	7.7 (15)	8.8 (26)	9.6 (20)	10.5 (43)	7.5 (14)	9.1 (48)	12.1 (54)	10.9 (5)	12.7 (12)	11.2 (6)
2	10.7 (40)	8 1 (39)	8.3 (65)	9.1 (59)	10.3 (35)	11.2 (42)	8.3 (63)	10.1 (53)	12.5 (50)	13.4 (46)		
3	17.7 (58)	8.9 (41)	9.6 (17)	10.2 (34)	10.5 (11)	16.5 (1)	9.0 (7)	12.9 (28)				
4		9.1 (64)	9.8 (10)	10.5 (31)	10.6 (47)		10.6 (13)					
5		9.8 (3)	10.4 (30)	10.2 (34)	10.7 (51)		12.5 (55)					
6		10.1 (57)	11.0 (60)	12 1 (45)	11.5 (8)		13.2 (9)					
7		10.2 (4)	11.2 (23)	12.8 (24)	11.8 (62)							
8		10.3 (36)	11.4 (32)	14.6 (16)	11.9 (22)							
		10.3 (66)										
9		10.4 (38)	12.4 (25)		12.2 (52)							
10		10.6 (37)	12.6 (44)									
11		11.5 (61)										
12		11.8 (21)										
		11.8 (56)										
13		12.0 (29)										
		12.0 (33)										
		12.0 (18)										
14		14.4 (27)										

cost control systems, it becomes exceedingly difficult for us to go much farther without causing so much disruption in any given plant, that most firms refuse to participate. These six categories are major items that will highlight the largest areas requiring your attention. Once this is known and recognized, a more detailed analysis can be made by the individual plant in a manner preferable to its management.

Since the pounds consumption data reflect the size and productivity of the plant, they were used as the common denominator for comparative purposes. This allows for plants of comparable size to be analyzed on a more justifiable basis. Major breakdowns were made at 1 million-lb. consumption increments, for example: 1 to 2, 2 to 3, etc. up through 12 to 13 million lb. In addition, the plants were ranked in each category from best to worst with regards to their waste performance, i.e., least waste first and highest waste last. After each waste figure is a figure in parentheses which is the code number of the plant having that waste figure. The participants in the survey have already received this information and the code number assigned to their plant. Each firm knows only the identity of their plant.

Table I shows the pounds consumption versus pounds baled waste. As you can quickly see, we are talking in terms of board, which constitutes the greatest percentage of cost in your operation. It is interesting to note that in the 2 to 3 range which appears to reflect the most common box shop size, that there is an extremely wide range of results. We go from 167,074 to 346,695 lb. This is even greater in the 3 to 4 consumption range from 275,531 to 696,393 lb.

Table II compares pounds consumption to percentage of net waste and also to percentage gross waste. Here again, we see the waste differences in performance within given categories. The lowest gross waste figure for any plant was 7.5% and the highest was 17.7%. The lowest net figure for any plant of any size was 4.3% and the highest was 16.1%.

The pounds consumption is compared to percentage fabricating waste and percentage combining waste in Table III. Again, the differences are great. The lowest percentage fabricating waste was 0.3% and the highest was 7.4. The lowest combining waste was 1.8% and the highest was 11.5%.

The committee has had to assume that all data were carefully checked and presented. We have no way of verifying

Table III

	Pounds consumption in millions											
	1–2	*2–3*	*3–4*	*4–5*	*5–6*	*6–7*	*7–8*	*8–9*	*9–10*	*10–11*	*11–12*	*12–13*
					Fabricating Waste							
1	3.2 (58)	0.3 (49)	0.3 (65)	1.6 (31)	1.2 (52)	1.0 (42)	1.2 (63)	2.5 (33)	3.5 (54)	3.2 (46)	0 7 (12)	5.1 (6)
2		0.7 (64)	1.5 (15)	2.0 (26)	2.4 (51)	3.0 (1)	1.3 (55)	3.9 (48)	5.5 (50)			
3		1.0 (61)	2.1 (23)	2.1 (24)	2.8 (22)		2.1 (13)	4.0 (28)				
4		1.2 (57)	2.3 (32)	2.9 (16)	3.1 (8)		2.9 (9)					
5		1.4 (3)	2.8 (30)	3.4 (45)	3.9 (11)		3.6 (7)					
6		2.1 (4)	3.5 (17)	5.7 (34)	4.5 (62)		4.2 (14)					
7		2.4 (27)	3.7 (25)		4.8 (47)							
8		2.8 (33)	4.4 (60)		5.7 (35)							
9		3.2 (29)			6.6 (20)							
10		4.3 (56)										
11		4.5 (36)										
12		5.2 (66)										
13		7.4 (37)										
					Combined Waste							
1	11.5 (58)	2.5 (37)	3.4 (60)	3.7 (34)	1.9 (20)	4.6 (42)	1.8 (14)	3.5 (48)	5.4 (50)	3.7 (5)	5.6 (12)	3.7 (6)
2		3.8 (3)	4.1 (15)	5.3 (26)	3.0 (35)	10.0 (11)	3.4 (63)	5.4 (28)	5.5 (54)	7.7 (46)		
3		4.1 (49)	5.1 (25)	5.7 (31)	3.5 (62)		3.7 (7)	5.9 (53)				
		4.1 (56)	5.1 (65)									
4		4 2 (29)	5.2 (30)	5.8 (24)	3.6 (47)		6.0 (9)					
5		4.4 (36)	5.4 (17)	6.1 (16)	3.8 (8)		6.2 (55)					
6		4.5 (57)	5.8 (23)	6.6 (45)	4.0 (51)		6.5 (13)					
7		5.1 (64)	6.1 (32)		5.6 (11)							
8		5.7 (66)			5.9 (22)							
		5.7 (27)										
9		6.1 (4)			6.6 (52)							
10		7.6 (61)										
11		7.7 (33)										

data so must take then at face value. Before you lightly explain away the extremes in data as inaccuracies, however, we would like to state that there appears to be a pretty consistent pattern for any given plant size.

The data submitted came from every geographical part of the country, from all types of box shops, all sizes of plants, and undoubtedly reflect all types of business from extremely short runs to extremely long runs. As near as we can check industry data, this is approximately 27% of the industry production for September, 1953.

We can make a few generalizations from the survey:

1. Waste surveys of corrugated can be made using common waste term definitions on an industry basis. To the best of our knowledge, this is the largest survey taken to date on an industry basis.
2. The size of the plant and productivity do not appear to determine whether a plant's gross or net waste percentage is high or low. Large plants can have high or low waste as can small or medium sized plants.
3. The amount of fabricating or combining waste appears to have no relationship to size of plant.
4. The quantity of waste by category will vary considerably within any given size or series of plants.
5. Waste control is dependent upon the emphasis on waste exercised within a given plant rather than size of plant, equipment, or type of business.
6. During September, the plants participating in the industry consumed 321,367,566 lb. of board. This amounted to approximately 27% of the industry production. These same plants baled 243,438,000 sq. ft. of board during September. The last sales price available is for December, 1953, which amounted to $16.36/sq. ft. The sales value of the board baled during September was $3,982,646 or approximately $4,000,000. If we assume that board costs are 50% of the value involved, we are still talking $2,000,000. Since we are only sampling 27% of the industry for the month, the industry would have wasted $16,000,000 as related to sales or roughly $8,000,000 on an assumed 50% due to board costs. You will readily understand that the board cost estimates are on the conservative side. The yearly figure is roughly twelve times these sums.

The committee is very interested in learning of the industry's reaction to this survey as a guide to future activities. It is a lot of work to collect such data in the plants and effort on the part of the committee to tabulate and present the information. We would appreciate being advised if there is a desire to see this survey approach duplicated in the future. If you wish us to repeat the survey, please write to the author.

The Importance of Viscosity Control

L. O. CARLISLE

One year ago, it seems like such a short period of time, the speaker was privileged to address this group on the subject of "color coating." If ever there was a "fish out of water"—you had it—and so it is with a great deal of pleasure that I can appear before this group with a subject upon which we are more thoroughly versed.

Viscosity is defined by Webster as "being viscous" and viscous as "sticky or thick like syrup or glue." The New Century defines viscosity—"the state or quality of being viscous, in physics—the resistance of a fluid to the motion of its molecules among themselves; also, the capability in a solid of changing shape gradually under the action of gravity or external force." Viscous is defined as "sticky, adhesive, or glutinous; hence of a glutinous character or consistency; imperfectly fluid; ropy; thick." Your speaker prefers the definition of a Dutch paste man, who simply says, "just right," "too tik," or "too tin."

Having defined viscosity, the necessity of being able to measure the "thickness or the thinness" of a liquid, with some degree of accuracy, is apparent. There are many viscometers, or viscosimeters, as some choose to call them.

L. O. Carlisle, A. E. Staley Mfg. Co., Decatur, Ill.

Very recently it was my pleasure to learn about the C.I.R.F. viscometer, which took half an hour to describe and demonstrate. Obviously, the time allotted could be consumed in describing the instruments for measurement, but the speaker will not take advantage of this opportunity.

A few accepted viscometers, Stormer, Scott, C.I.R.F., and similar instruments, measure viscosity by resistance of the fluid which can be recorded or noted. Probably the most used viscometer is the one where the index finger and thumb are immersed in the liquid, carefully rubbed, and the expression (1) "too thick," (2) "too thin," (3) "about right"—is the notation on a report form—shall we call this the "fumble method?"

Bauer, in his initial work, realized the importance of this characteristic in adhesives, and the viscometer, to which we refer as the "Bauer funnel," was adopted as a standard. Ninety per cent of the paste users today, use the Bauer funnel; so from this point on, all reference to viscosity will be considered as seconds in the Bauer tube or funnel. This measuring device is generally a brass tube which holds 310 ml. of liquid; has 2 pegs, or points, spaced 100 ml. apart, and the paste flows through an orifice so drilled to permit water at 70°F. to be timed at 15.4 sec. We consider 15 sec. as standard calibration of the instrument.

Several years ago, Mr. Killinger very capably presented a paper to this group on the subject "How to Control Viscosity." The TAPPI survey on paste emphasized viscosity fluctuations, but it is our considered opinion that the importance of control has not been forcefully enough brought to your attention and perhaps a better title would be "The Necessity of Viscosity Control."

Some background on the history of this paper is in order. At lunch one day during the last meeting here, your very capable chairman was casting about for titles that would be of interest to this group. Your speaker made a suggestion, and here I am. Moral—be quiet!! The most gratifying part of this was that it enabled us to immediately start work on the project and it was turned over to our technical service department. The work, facts gathered, and the information presented, represents the efforts of six men, working in conjunction with 40 odd box plants over a period of 10 months. It would be impossible to give credits here. For obvious reasons, some wish to remain anonymous, but if you will consider your speaker as a clearing house, presenting the information gathered by many, you will, in effect, be saying, "thank you" to the contributors.

The most salient fact noted in sifting the information was that viscosity fluctuations change the amount of adhesive applied to the sheet, with all other factors constant. Let us get our teeth into this fact early because there are opinions to the contrary. With constant machine settings, fingers, glue rolls, hold-down rolls, any setting which would change application was left unchanged. In *every* operation it was noted that *an increase in viscosity* brought about a *decrease in consumption*, and *a decrease in viscosity* brought about an *increase in consumption*. Not being satisfied with manual readings of viscosity, we purchased and installed a recording viscometer. Careful measurements were made on paste inventories on each shift; the production records were available, and these were applied to the recorded viscosities. To repeat, the salient fact was viscosity fluctuations brought about a variation in the amount of adhesive applied. It would be impossible to report on all the records but we have records to show:

1. Viscosity decrease from 37 to 26 sec. shows 2.25 lb. dry starch increases to 3.14 lb. per thousand sq. ft. at the low viscosity with all other conditions constant.
2. Over a period of 1 month, with no adjustment to glue roll clearances, increased consumption was attributable to a faulty stop watch. This watch had been repaired, and when returned from the jewelers would not accurately record the time. It was discovered quite by accident, and a check-back on the consumption increase started the day the faulty watch was returned.

In this instance everything remained constant, even the viscosities, which were untrue due to the faulty watch. It is nice to be able to say that when viscosity was corrected, consumption returned to normal. The increase here was 0.4 lb. dry, with a viscosity variation of 4 sec. due to the faulty watch.

3. Accurate records of viscosity, production, and consumption were kept for a period of 1 month on all three shifts at another plant. During the first shift all paste was made and put into storage tanks. While fresh paste was added the viscosity did not fluctuate but the second shift used $1^1/_2$ the amount used on the first shift, and the third shift used $1^1/_2$ times the amount used by the first shift.

These are facts, not based on estimates, but actual records.

Before we could establish our minds, and present for your consideration, the foregoing, it was necessary to consider other contributing factors to this increase. Immediately it comes to our attention that different corrugating mediums and different liners will absorb more adhesive. The answer there lies in the fact that we have considered plants known to run one corrugating medium. The average or balance will result in a uniform cross section of liners, so we can confidently state that the components are representative of the average. Machine changes or adjustments were limited to the supervisor, and were noted on the run sheets. With the precautions taken, we conclude that the viscosity change reflects the consumption figure.

The economics of this is obvious. If you can make good board with the lower figure, anything above that is waste. Assume your adhesive cost to be 20¢ on the first shift, and 30¢ on the last shift. Half a million feet on the third shift will cost you $50. Can you afford it?

Remember, you operate about 275 days a year.

Assume the economics is not unsound. What beneficial, or detrimental effect will this "flooded" or "starved" condition have on your board? A "starved" joint doesn't present too much of a problem. In general, the baling department is large enough to handle it, but they get it after it has been either partially or entirely through the process. That is the most expensive part of your business. A "flooded" joint will cause warp, washboarding, decreased flat crush, decreased compression, moist surface, with ink drying a problem, and a piece of board more readily damaged in the weight rolls, pull rolls, belts, etc. In short, a substandard box, that is, below the quality of which you are capable.

Gleaned from many reports are comments such as, (1) "We were warping a 'B' flute sheet badly, which was corrected by increasing the viscosity of the paste on the double-backer." Actually this can be accomplished to a degree by adjusting the clearances in most instances—one exception being a highly absorbent corrugating medium. (2) "We were using a lightweight liner on the double-backer which was washboarding through the machine. We went up in solids and viscosity and succeeded in making a very smooth sheet." (3) "The board at the knife felt 'soggy,' which was corrected when we got to normal operating viscosity." (4) "The flat crush was ruined through the corrugator and pull rolls on the presses, due to excess adhesive. They have stabilized viscosity and corrected this condition."

To allay the fears of some, and possibly prevent another criticism from the floor, the foregoing is as true of sodium silicate as it is of vegetable adhesives. While our experiences were somewhat limited, it was determined by means of Baumé variations that as the silicate was thinned, the consumption increased and vice versa.

Quite frankly, we became more involved in this subject than was originally intended. To make a point, it will be necessary to digress slightly, still staying on the subject. During our study we were questioning a viscosity reading always starting at 9 a.m. The plant started at 7 a.m. and we were interested in those first 2 hr. We were advised that the viscosity was "always high in the morning and not representative; that the boss wouldn't understand, so they waited until it leveled out." You have all had board that "didn't have enough on" or cracked when flexed. Trace it back o your run sheets, determine when it was made, and you wi find most of it was made on a start-up. To stress the poin when we became involved in the subject and learned somethin of interest, unlike the ostrich, or the fellow who didn't tak viscosities early in the morning, we didn't hide our heads i the sand.

Probably one of the most significant facts to which entirel too little emphasis is placed, is the effect of temperature o viscosity. Again the fathers of corrugating adhesives realize the importance of temperature and, added a T.V.C. unit t the system. T.V.C. is an abbreviation for temperature vis cosity control. If you make no effort to control temperature forget viscosity because you are whipped. We found tha in general, paste being pumped through the system, past pans, and overflow, tended to take on heat to a temperature o 100°F. At that temperature let us assume it had a viscosit of 35 sec. There is range above and below that point where rule of thumb can be applied whereby 1° rise or fall in tem perature will bring about a 1 sec. decrease or increase in vis cosity. The range is limited, but will be sufficiently accurat between 95 and 105°F.—why then, if the paste temperatur stabilizes at approximately 100°F., don't we make it at tha temperature and through tank controls, hold it at that tem perature? It will have as much effect on viscosity stabilizatio as other contributing factors.

The receptivity of the corrugating medium to water o adhesive was another interesting observation. A sheet wit a high penetration number, indicating a low absorbency rate required a reduced viscosity for best bonding. This sam lower viscosity paste will bond an absorbent sheet but wil soften the board because it takes too much adhesive too rapidly. If you run several corrugating mediums you wil readily see the necessity of viscosity control.

The pin pull test is affected by viscosity. A thin paste or the single-facer gives a higher pin pull than a thick paste This is reversed on the double-backer. Please do not misconstrue this to be an advocation of a dual viscosity system as that is another subject.

Water, whether in the form of steam, as a vehicle in adhesives, vapor, or humidity has a very important part in your product. Too much in the wrong place ruins the end result. When you consider the fact that when you vary the amount of adhesives applied you add more or less water to the board and adhesives, as we know them in the corrugated industry, are predominantly water. To nail this down, try immersing a box in water and then subject it to the usual tests. Why then bathe it in adhesive?

The interesting observations and results noted in this study all lose stature when the conclusions of the participants are correlated. Without exception it is agreed, that any normal viscosity can be standardized on a machine, the proper machine adjustments made, and good quality board produced economically so long as too great a viscosity fluctuation does not occur. But, as a closing thought, all evils do not stem from viscosity. Viscosity control will not correct all of your problems. There are those among you who will return to your plant and viscosity will be a much discussed subject. The sole purpose of a controlled viscosity is the elimination of a variable which can increase costs and decrease quality. It is a daily job, the year around, and if the thoughts and facts presented provoke some action on your part, it has been well worth the effort. If, on the other hand, it is accepted as a "cure-all" you have missed the point entirely.

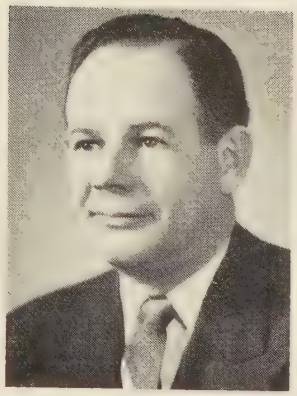
We would like to leave you with the following questions:

1. How frequently do you calibrate the viscometer?
2. How frequently do you check viscosity?
3. Do you keep a record of viscosities? Temperatures?
4. Do you check temperature when you check viscosity?
5. Do you heat or cool paste in a storage tank?
6. Is the method of taking viscosities uniform among those testing?

7. How frequently do *you* check viscosity or have a qualified supervisor check?
8. What timing device do you use? A wall clock? An almost invisible small second hand? A stop watch?
9. Do you have daily consumption records?
10. Are you satisfied that you are doing the best job possible?

Quality Specifications of Corrugated Board from a Consumer's Viewpoint

EARL B. CANDELL



L. O. Carlisle, A. E. Staley Mfg. Co.

E. B. Candell, General Electric Co.

My presentation to you may not be in line with your usual subjects. In fact I am not sure that customers appear on your program. Since I have never attended one of your sessions before, I am not familiar with what you cover and how the subject matter is customarily presented. I presume that most of the talks would be on fabricating and management problems as related to corrugated box manufacture. These subjects are definitely out of my field.

Several months ago I gave a talk to the Lake Erie Section of TAPPI. This was a two-speaker program, in which the consumer of boxes was requested to state what he expected of the box manufacturer and the other speaker, representing box manufacturers, was supposed to answer by saying how the box manufacturer could meet these demands and what he had to offer.

In the course of that talk, I raised some questions which provoked considerable discussion. I have a feeling that either someone wanted another crack at answering those questions or is expected that answers might be forthcoming from this group. Maybe they are foolish questions to you who are constantly working with boxes, but from our viewpoint, they seem logical. Possibly other users may have the same questions so that your answers would be welcomed.

I was a little reluctant to speak before the other group, just as I was in appearing here because, certainly there is little that I can tell you that you do not already know about the science of box making. But then I was told that my subject was not to tell you how to make boxes, but to tell you what a consumer expects of boxes. And it is from this viewpoint that I speak. No customer should hesitate to state what he wants and would like to get. You can hardly be expected to read his mind, whether he gets what he expects is up to you as suppliers, and if his desires are not practical or attainable, then you must tell him. Possibly there is a gap between what is desired and what is available; if so an effort should be made to decrease that gap and that is when progress is made.

Before getting into my subject, I want to compliment the paper industry on the progress that has been made in the art and science of box manufacture. There are few industries in the country which have gone through such a rapid development and expansion. New fields have been opened and the demands have been terrific. I suspect that your TAPPI organization has played a substantial role in this development. Certainly this is another example of how American industry can work together voluntarily to accomplish great results. It is a good example of the American Way of Life.

Well now to my subject of what the customer wants. Without appearing to be flippant, I could summarize all that I'm trying to say in these few words: the customer wants what he wants when he wants it. This is a very general statement, with which no one would seriously object. When I say this, I'm assuming that the customer knows enough about what he wants, to order it correctly. Certainly it is most unreasonable for him to assume that you know what is in his mind and thus excuse him from knowing anything about how to set down in order form or specifications what he wants.

So, with this assumption, I might reword the statement and say: the customer wants what he *ordered* when he wants it. And here again I presume that none of you would seriously dispute that this is unreasonable.

Now let's break this down some more. Let's take the second part first, *when he wants it.* As men in business, you all recognize the importance of proper delivery schedules. In your business you must schedule your raw materials to match up with the order you are manufacturing, and so it is with your customers. Production schedules are laid out and raw materials are scheduled to arrive so as to have minimum inventories consistent with good operations. It is probably the rule today (I know it is in our business) that most plants' capacities are severely taxed so that the amount of space given over to stocks of raw materials has been reduced. This calls for closer scheduling. Much of the scheduling is based on promise of deliveries and faith in the supplier to keep his promise.

The orders are placed with a delivery date specified. Acceptance of the order by the vendor is likewise acceptance of the delivery schedule. The time to talk about delivery schedules is *before* the order has been accepted.

And while on this subject of inventories, the consumer assumes that his stocks are all of good quality. Better not to have the stocks at all than to have them only to find that after production has started they cannot be used.

This item of "when he wants it" must be obvious to you all so I will not spend any more time on it, although I will talk more about quality.

Now for the item: "what he ordered."

Let us assume that he ordered a corrugated box since that is the item most of you are interested in. When he ordered it, he ordered a certain size. Since most of our boxes are engineered, I mean that they are designed to hold a specific product, there may be inner pieces such as die-cut pads, partitions, etc. that must all fit together. Plus or minus $^1/_8$ in. can often cause trouble when packing. And the type of scores can affect the internal fit. I believe you have had some discussions in your organization about proper scoring.

Size of box is also important to the customer who uses machine case sealers. Here variation in width and height can cause a lot of trouble. If the machine is set for the widest box, then the flaps won't meet well for the narrower box, and conversely, if the machine is set for the narrow box, the flaps will overlap for the wider box. Also, too much pressure can be experted by the side rails and the box pulled out of square. So box size is important.

Material was specified: most specifications will state what kind of liner is desired, less frequently the exact corrugating medium. Usually a range of material is given. To some customers, the type of material is not too important, to others

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it is very important. In our case we are quite specific and we really want what we specify. By that I mean we want fourdrinier kraft and not cylinder kraft or jute when it is itemized on our specification as fourdrinier. Each of these materials is good and has a proper use, but when we order one type, we don't want others substituted. There is a reason for this. For one thing—weight. Ours is a lightweight fairly bulky item—many thousands of packages are used. In shipping, we don't weight every package, but operate on average weights. Check weights are made periodically for the various package sizes and these weights are used by our traffic and billing departments. If they are to be accurate, then we must be uniform in the type of material we use.

Another factor is that of automatic case sealing. Different materials and finishes react differently with the same glue. These packages go through these machines at a pretty fast rate of speed so that adjustments cannot be made for variations in box materials. Therefore, when we put out a spec for a specific material we expect each vendor who supplies it to use the same type of material, not something "just as good."

In addition to listing the type or kind of material, we list basis weight rather than caliper of stock. We believe that this is a closer way of approaching the board quality than by using merely caliper. While we can't measure the basis weight of the individual sheets very well, we can weigh the combined board and from that appraise pretty well what we are getting.

Strength may be specified in several ways. First, there is the bursting strength required by the freight classifications. We have no alternative but to specify this. Even though we are using an exception package, bursting strength will be shown on the spec. There are two other values which are coming into more general use, one—the puncture test of the board and the other the compression strength. In our own use we are putting greater dependance on these two factors and in most instances list the values expected of the specification.

These two factors, puncture test and compression, are very important and to our way of thinking define what we want better than anything we can tell the vendor. A box to store and carry our product safely must be able to withstand certain compression loads and resist puncture from sharp objects. By experience from observation and calculations we know what we need and can get from a first class operator. In our specifications we list minimum values below which the average of a sample of five boxes should not fall.

Failure to meet these values is objectionable and makes the lot subject to rejection. It is our belief that the box quality can be largely expressed by a comparison of these three factors: basis weight, puncture resistance, and compression strength.

There are two other things appearing in the specifications, printing and manufacturers joint, both of which can affect the performance as well as the appearance of the box.

Most people are taking advantage of those big areas on the box to advertise both their product and their name. One of the first things our customers see is the outside of the shipping case. A poorly printed case is very obvious and does not speak for quality. If we are sloppy and indifferent in the appearance of our shipping cases, the inference can be made that we are also poor in the quality control of our own product. Appearance is a very important thing.

This carries over to the color control of the printing. Many companies have certain color standards which they work to and customers frequently associate the color to the company. So uniformity of color is important. This is particularly true when boxes made by different vendors meet in our customer's stock. Here again, uniformity of color bespeaks uniformity of product.

We also are concerned with how that printing is applied, because we know that too heavy an impression will break down the corrugations and give poor compression strength to the box, or in other words will jeopardize the stacking strength of the box.

Materials used for manufacturer's joints are usually quite satisfactory. There was a time when we would accept nothing but cloth tape, but these other materials have been improved so that we now accept most any which will not break under the compression test of the box or during the drop tests of the packed container. The greatest trouble we had was with sisal tape which was too stiff or poorly applied. We received many boxes which broke apart at the manufacturer's joint when our operators opened the cases for packing. I have not heard of a complaint like this in a long time, so it is evident that this material has been improved.

While on the subject of printing, I would like to refer to two things; first the importance of following the printing layout as it is given on the specifications. Care and thought was given in preparing the printing specifications and they should be followed. Changes in layout by the vendor causes confusion to our operators. Operators are creatures of habit and look to certain places for the identifying number and also the space for pasting the address and contents tickets. Changes in these locations slow them in their work.

The second is the manner of showing the date of manufacture of the box. I wonder why there can't be uniformity among box makers in how this date is shown. There are stars to count, letters to figure out, numbers in various arrangements, and even no dating at all. This date *is* important to the purchaser, for two reasons: inventory turnover and a means of identifying a specific lot, should there be any difficulty, which needs further checking.

What is wrong with just a simple figure for the month and one for the year, the two separated by a dash, these placed adjacent to the box maker's certificate? You could make our job just a little easier, if this simple thing could be done.

And the last item shown on the specification is the manner in which the boxes are to be delivered to the purchaser. The number of boxes to be bundled or tied together is given. Deviation from this causes confusion in stock keeping and inventory control. Sometimes pallet loads are requested.

There are possibly other things which certain users need to put on their box specifications, such as flat crush which to some is a very important thing, but I believe I have listed the principal ones.

Before I leave this subject of specifications, I would like to raise a question, since I am addressing a box makers group. Why can't there be a uniform code developed for specifying the materials which go into making a box? To write out furnish, basis weight, and caliper is quite cumbersome and time consuming. This must be true, otherwise coding would not be used so generally. But, why can't this code be common for everyone? Some people use numbers, some letters, some numbers and letters. We in General Electric even have more than one code system in use. Why? We are all talking about the same materials otherwise we couldn't let you know what we want. Why can't there be standardization in the paper business on such a fundamental thing? Other trades have long since recognized the importance of standard specifications. I realize that many of these pet systems have been in use for a long time, but does that mean that we have to have them forever? I would think that your TAPPI organization would be an ideal medium to work out this standardization and will venture to say that there would be no trouble in getting ASTM to go along with it. Maybe the two, through such places as the Forest Products Laboratory, could work it out together. Our SIPMHE group would be another means of getting together on this. I know that this is not a fundamental thing necessary to the advancement of the boxboard industry, but it would be helpful in establishing

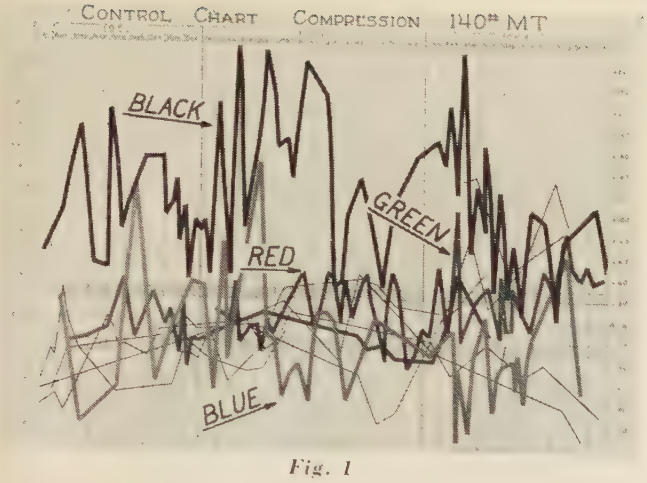


Fig. 1

it on a more scientific level and would eliminate some confusion which exists today.

And while asking questions, I would like to raise one more and this hits right at quality. What degree of control is reasonable and practical in establishing the burst test, puncture test, and compression test? By that I mean, how much variation from an average should be considered good for these tests or in other words, at what degree of spread or range is the process considered to be out of control? We have run across some terrific spreads in our testing of materials, or at least they seem like terrific spreads to us. Based on any standards of operation of ours, the product is definitely out of control.

I mentioned our testing, you might be interested to know why and how we test boxes.

As you probably know, we have been large users of corrugated boxes for many years, and we have had a package design and specification section for years. I can't say for sure, but I would guess that our activity is about as old as any company in the country. And until just recently, we bought our packing materials entirely on faith that our vendors did give us just exactly what we specified. But our purchases grew into some very large figures. Nowhere else in our operations did we purchase such large dollar values, without checking to approve the quality and uniformity of the product. Not even in our own operations, where one of our plants makes and sells to another of our plants, would we accept such quantities without check-inspecting it. So it was just logical and good business that we should check packing material.

Another reason for setting up our testing lab was to determine just how we could specify puncture test and compression strength for each individual box size. As I said before, we felt that these two values were fundamental in defining what we expected for the box.

There were various figures published by some laboratories, which gave values for compression in terms of perimeter inch and for variously proportioned boxes. These we used as a guide but decided that before any actual figures were given by us, we should have a background of tests which would prove that such values were reasonable.

The first thing we did was to build an air-conditioned test room. In this, the material to be tested was first conditioned so as to reach a stable value of 73°F. and 50% R.H. Sampling was set up to evaluate typical boxes purchased from a number of vendors. A sampling schedule was developed and certain of our factories instructed to send in six samples scattered throughout the shipment of each lot of boxes. Since most of these boxes are ordered monthly, this meant that we would receive monthly samplings. The program was started in March, 1951, and to date we have made over 450 routine tests.

It was not long before we found that there was a great amount of fluctuation in the samples—fluctuations in the sample lot, between lots of a specific vendor, and between vendors supplying on the identical specifications. It is from these tests that we raised the question: how much variation must we expect?

Before discussing some of these tests, let me say that all test results are confidential. Since we do use these in discussing quality with our vendors, we will give him the results of our findings on his box only. On any data, which I will present here, we have changed the vendor's code so there is no agreement between these charts and the real code numbers we have assigned to each vendor.

We gathered data for well over a year before we started to make any comparative analysis or set up normals. Using the statistical analysis method, we first made a monthly consolidation of the test results for each vendor for the 140-lb.-MT and 200-lb.-MT boxes. The sigma variation for compression and puncture were computed and curves drawn by vendor for each.

Time does not permit me to go into details of the development of these curves, nor a discussion of how sigma values are computed. I don't believe that is too important anyway, because you can clearly see the extreme variations we have encountered. Also, to conserve time and lessen the confusion, I'll only discuss the 140-lb. curves because they represent the greatest volume of our purchases.

Let's first look at the compression readings for the composite picture, then I will get into some specific box data. On this curve (Fig. 1) you will notice that there are five horizontal lines. The middle line is the average, the first line above and below is the 2 sigma variation, while the second line above and below is the 3 sigma variation from the center.

We expect that the average of any lot shall not fall below the −3 sigma line and to be in control according to a statistical appraisal of the test results, the averages should fall between the −3 sigma and the ×3 sigma lines.

According to the statistical method of analysis, 68.3% of all tests should fall between the 1 sigma lines, 95.5% of all tests between the 2 sigma lines, and 99.7% between the 3 sigma lines. Now let's look at the curves, first in total, then by vendor. You will agree, I believe, that based on the sum of all the tests, our value for the average line doesn't look to be too far off. The weighted average falls pretty well along this line, so from that we contend that our expected values as shown on our specifications are not bad.

But now let's see how individual vendors show up. Take the green line, until this fall all but a very few points fall between the 3 sigma limits. There was one point in February, 1953, that was very high and seven of the last eight tests have been high.

The red curve has likewise stayed pretty well within the limits, though a little more erratic than the green.

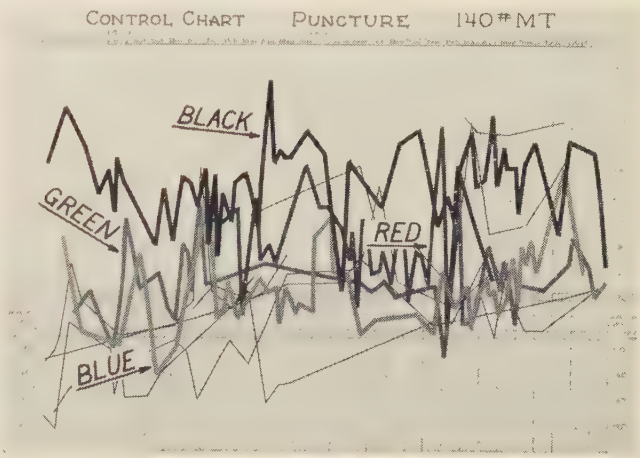


Fig. 2

Now look at the blue—here is a vendor that is all over the sheet, but mostly on the low side.

Then look at this black curve—practically all values are well above the +3 sigma line. Not only that but the variations are the most extreme on the sheet.

Remember, all of these vendors are working to the same specifications, so far as we know. After seeing these extreme variations our natural question is: why so much variation? Would you say his production is in control? Just how great a deviation is considered good practice? Frankly, we don't know your business, but from our viewpoint such extremes are not good.

The same condition exists on the puncture chart (Fig. 2). Let's glance at that. Here it appears that our average and 3 sigma lines are set too conservatively for the bulk of the readings are above the average and for a number of months were above the +3 sigma line.

Here again the green curve is in most instances between the black and the blue, although in the later months, the blue and green curves are fairly close together. The black continues to show high above all others but the amount of variation is not quite as great as for the compression curve. I repeat: why such variations and what should be considered good operations?

In case these composite curves are a little confusing to you and I wouldn't be a bit surprised they are because I must confess they have been to me, we can look at a specific box type. These composite curves were evolved by the boys who are making these tests, with the aid of our statistical analysis section. The same principles have been used here as are used for evaluating the quality control which our factories show in the manufacture of lamps. When I say that, I don't mean that the limits of variation or sigma values are the same, but the method of computation (using box test values) is the same.

Here is a chart (Fig. 3) showing actual values for compression, puncture, and basis weight for one specific box size. The test of each vendor are kept together. The three values for a specific test lot are recorded on the same vertical line. In the case of compression and puncture, the highest, lowest, and average of the five-box sample lot test is shown with the averages forming the curve.

I think this chart is very interesting for it shows a number of things. Let's first look at the comparison by vendor. These fellows are all given the same specification, yet see the variation between vendors of basis weight. And the level of the average puncture corresponds fairly well to the variation of basis weight.

Looking at the compression curve this relationship to basis weight is not as evident.

See the variation between vendor. Then look at the variation between sample lots within the vendor. Notice that the vendor giving the highest readings has the greatest variation—he can make awfully good boxes but is not very consistent. Both the variation of average and of spread or range of sample test are, we think, too great and hence show poor control.

Our statement to this vendor is that he is giving us a higher compression strength than is required to meet our standards, possibly because he is using more material—basis weight. A reduction in basis weight should bring his compression strength down to our requirements, and this reduction of basis weight should mean less board or stock weight and hence a reduction in price.

In other words, if our standards are set properly to give us the protection we expect, then there is no need to buy more.

What I have said here applies to this vendor up until the last seven tests. Here for some reason with little change in basis weight and puncture, his compression strength has dropped—why?

There is still another interesting point brought out on this figure. You will notice that vendor Y1 has some extreme

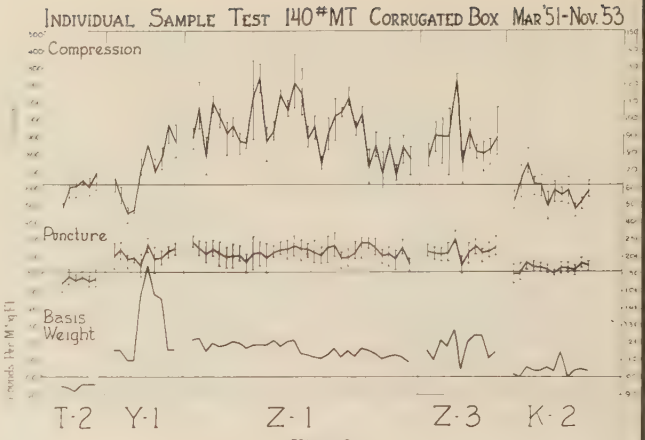


Fig. 3

variations in basis weight. The high values are due to his supplying jute instead of kraft. You see why we desire kraft—neither the puncture nor the compression increased in relation to the increased weight. The increased weight cost us more money in the form of increased transportation costs—weights per thousand square feet were about 50% greater.

Another interesting point is that of vendor T2. This fellow is not giving us as much basis weight as we expected, yet his compression is nearly right. Were he to increase his board weight to our standards, he probably would show just as good puncture and compression as the better vendors but on this chart he doesn't look good.

There are still other charts of comparisons which we have all of which are very interesting and informative, but time does not permit me to go further. They emphasize this problem of control of product.

We do not claim to be authorities on this subject: there are many people who make this activity their means of livelihood. We got into the work because we are charged with checking and protecting our quality. Setting up a specification is no guarantee to my employers that we are getting what we say we should have. Nothing would please us better than to find that this is an unnecessary activity. We still would maintain our laboratory because through it we can determine what we do want.

So getting back to my original subject—what does the customer expect of the vendor? We expect uniformity of performance for a given specification both between vendors and between lots of an individual vendor. It looks to us as though this quality control could be improved.

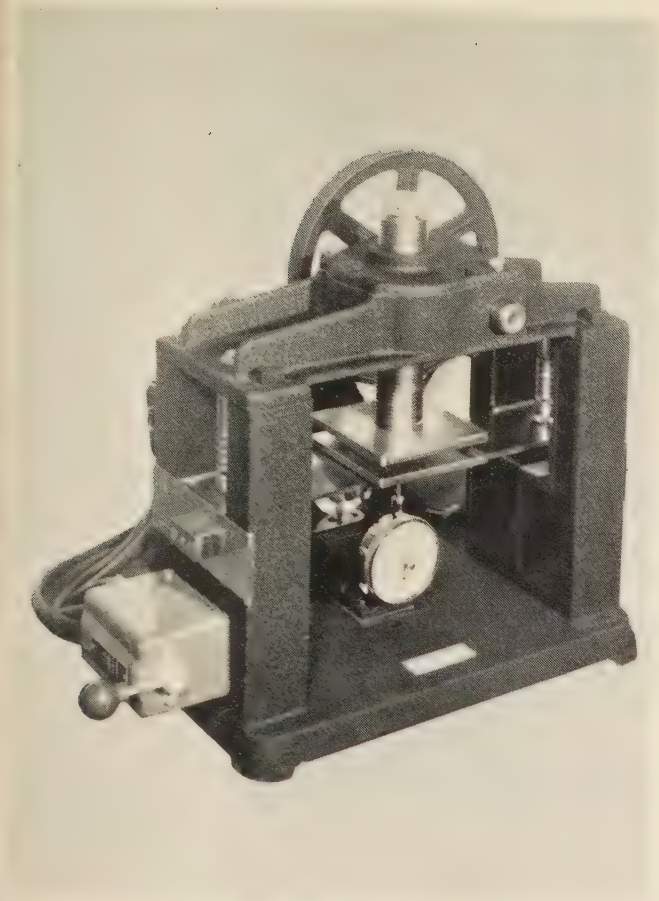
I wish to thank you for the privilege of speaking to you. It has been a real pleasure. I hope I have not abused this privilege and offended anyone, because what I have said has been in the interest of developing a more uniform product. In our own organization, we have worked on quality control and the surprising thing is that invariably, better control means better profits because of less waste.

The Effect of Moisture Variation Upon Standard Corrugated Test Procedures—Part I*

WILLIAM SCHOENBERG

INTEREST in the subject of this paper developed from the experience of a manufacturer of corrugated board who

* Prepared by WILLIAM SCHOENBERG, Lord & Schoenberg, in cooperation with EARL KNAPP, Hinde & Dauch Paper Co.; RUSSELL L. LEWIS, Ohio Boxboard Co.; JOHN LITTLE, Hinde & Dauch Paper Co.; CHARLES MARKEE, The Ohio Boxboard Co.; K. R. MARTIN, Fort Wayne Corrugated Paper Co.; MILTON YEZEK, Carton and Container Div., General Foods Corp., and Dura-Glass Center, Owens-Illinois Glass Co.



H & D ring crush tester
Testing Machines, Inc., New York, N. Y.

bought corrugating medium from several different sources. Noticed variation in strength of board and boxes was attributed, in part, to variation in strength of the different mediums used. Production decided to make a test of the strength of the different mediums, the report to be used as the basis of a recommendation to management. The flat crush test was selected as the basis for the study and tests were made and collated. The test specimens were not humidity-conditioned prior to testing as its effect upon test results was expected to be too minute to make such precautions necessary.

After a large number of tests had been made and the data properly recorded, it was decided to make a series of flat crush tests from a single board. Each sample of the series was to be at a different moisture content when tested. Each figure used was to be an average of the results of five tests. This would show the variation in flat crush test values at variations in percentage of moisture content, which were expected to be present but to be slight. This was to be done to be sure that the tests already made were reasonably accurate, and that they presented a reasonably true comparison of the test specimens already evaluated.

Upon completion, the results of this series of tests were very different than anticipated. Slight changes in moisture content produced major changes in flat crush test values. It became immediately apparent that flat crush tests are meaningless unless made under carefully controlled moisture conditions. But of greatest significance is the fact that the biggest changes in flat crush values occurred within the moisture range most likely to be encountered during board and box manufacture and particularly in the course of normal shipping, storing, and handling operations.

The shown effect of moisture change was so convincing that the first procedure was promptly discontinued, the carefully acquired data were discarded, and the original work was duplicated. However, this time all samples were brought to specified moisture content prior to testing for flat crush values. A similar test is described in detail with records and charts at D of the Appendix.

The D data and charts were shown to other corrugators who were likewise surprised at these test results which were more extreme than previous reports on this subject had led them to expect. Some companies duplicated the experiment. Each used his own papers but followed, in principle, the general procedure used in D. In each instance the results obtained were similar to those shown in D.

The flat crush curve shown on Fig. D-9 is similar to the curve that aroused much interest among many people in the corrugating field. Notice that, in this instance, minor variations in moisture content affect directly the flat crush test values to a considerable extent.

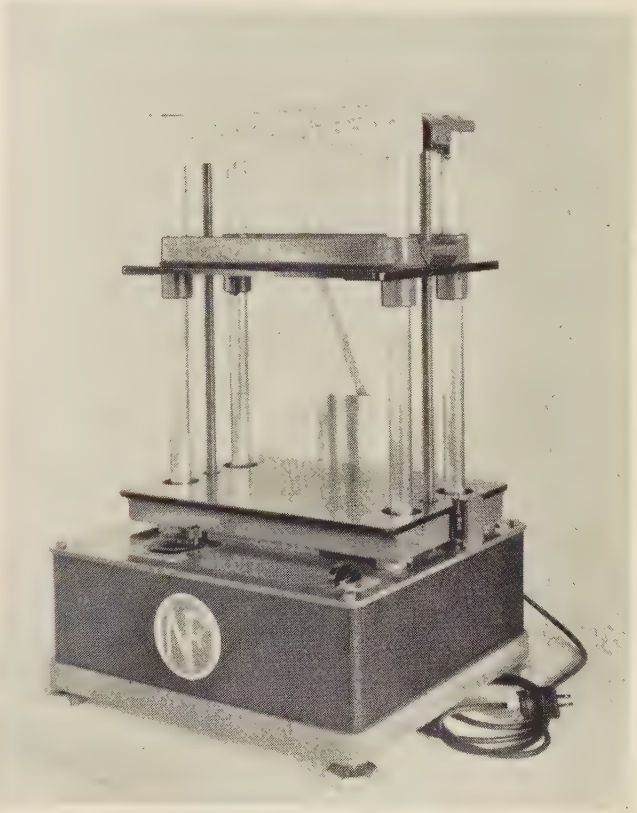
The work did prove, however, that, for the papers evaluated:

Moisture change has a greater influence upon flat crush test values than has been generally accepted as fact.
This effect is most pronounced in those percentages of moisture content that are most prevalent—where the changes in moisture content can cause the most trouble.

This work also tends to again emphasize that:

Comparisons of the characteristics of paper products are meaningless unless there is a common basis for the comparison, unless the products being compared have the same moisture content at the time the comparison is made.
A measurement made at any given moisture content percentage is no indication of what that measurement will be when the tested material reaches another percentage of moisture content.

That moisture content, and more particularly variation in moisture content, affects the properties of cellulosic products is well known. There is a wealth of literature on the subject. Some of the information is available to all. Some resulted from investigations financed by special groups and is only



Container compression testing machine (750-lb.)
National Forge and Ordnance Co., Warren, Pa.

available to members of the groups. It has long been acknowledged by TAPPI.

TAPPI Standard T 402 m-49, "Conditioning Paper and Paperboard for Testing," calls for test specimens to reach equilibrium with an atmosphere with a relative humidity of 50% and a temperature of 23°C. (73°F.)—and to do so from the *ad*sorbed rather than the *de*sorbed side. This test, incidentally, has been adopted by the American Society for Testing Materials (ASTM designation D 685). The purpose of this test is to provide a uniform 12-in. ruler for paper testing.

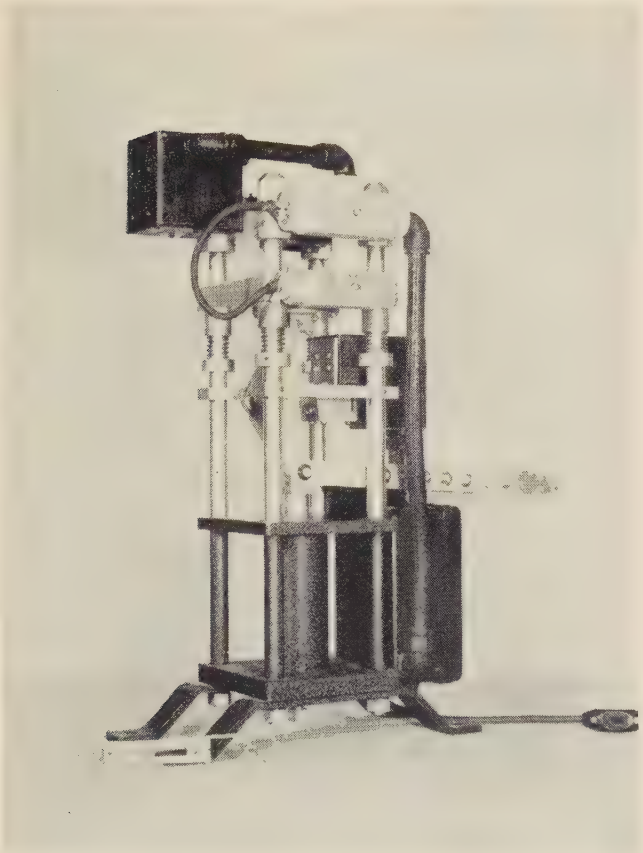
TAPPI Standard T 412 m-53 for making moisture determination calls for similar procedure. It is concurred in by the ASTM (D 644–44) and by the American Chemical Society.

The interest aroused by Fig. D-9 is not because in these experiments the flat crush value at 14% is the figure that truly determines whether corrugated boxes made from components herein evaluated are, or are not, suitable for the purposes intended. The interest was engendered by the fact that Fig. D-9 proved that the flat crush value could decrease to such a great extent between such few points of moisture content percentage and that this change would be the greatest within the most important range of moisture content percentage. It was this information that interested our group in the subject that resulted in this paper.

We also wished to determine if the results of other test procedures would be affected to a similar extent by corresponding changes in moisture content percentage.

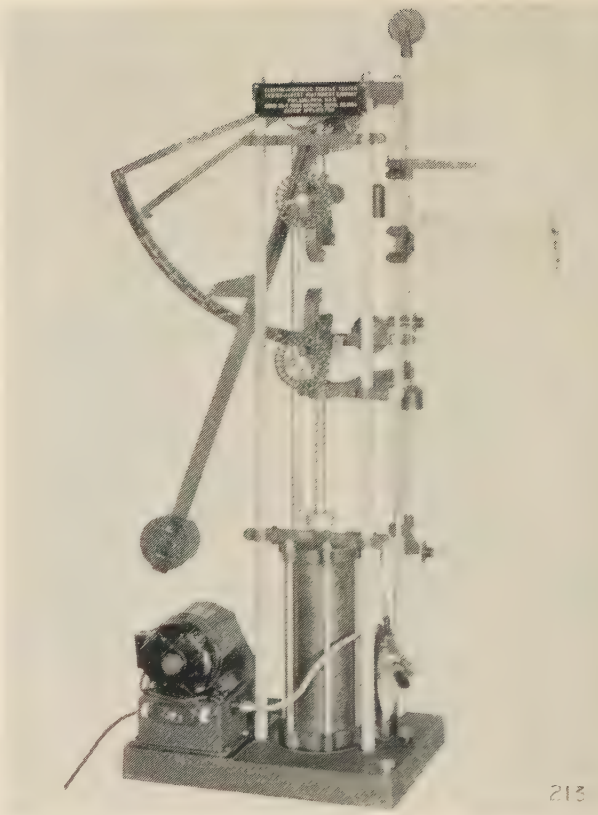
This paper is a compilation of work done by seven men representing five different companies that manufacture corrugated board and boxes. Only the compilation was done by me.

Each company used its own instruments and experimented upon its own papers. No attempt has been made to compare the efficiency or effectiveness of any of these papers o instruments. Actually there is no basis for such a compari son. We hope that no one will use any of these data for tha purpose.



Single-flute corrugator

Fox River Tool Co., for Institute of Paper Chemistry, Appleton, Wis.



Electro-hydraulic tensile tester Model 35-4

Thwing-Albert Instrument Co., Philadelphia, Pa.

The investigations made followed similar but not identi procedures. All reports, however, are detailed showing a curately the exact procedure followed. The testing equi ment used is listed, together with the name of the manuf turer. Pertinent observations are noted. All test resul are both listed and charted.

When our group decided to do further work regarding th effect of moisture variation upon standard corrugating tes results, we decided to limit our investigation to only thos tests which evaluated: the strength of corrugating mediu and the strength of the adhesive bond. It was also decide that each evaluation would be concerned only with test r results within a reasonable working (corrugating) moistu range and a reasonable storing, handling, and shipping rang

The ideal component moisture content is generally cor sidered to fall anywhere between 6 and 8%. However, mos corrugators find that they must be able to handle medium a any moisture content between $4^1/_2$ and 9%, frequently a even higher moisture contents. We have, therefore, arb trarily set our corrugating range from $4^1/_2$ to 9% and th SSH (shipping, storing, and handling) range up to 14%.

The tests evaluated are: flat crush, single fluter, ring stif ness, and pin adhesion.

We are not interested, as far as this investigation itself concerned, in the effectiveness of the tests evaluated, nor i the importance of testing, nor in the benefits that migh accrue from testing. One side of this argument has bee ably presented in the excellent paper by Earl Candell of th General Electric Co. The other side of the argument wi probably also be ably presented in the discussion period whic will follow this panel. However, we imagine that the fin decision, for any company, will be made by two items. On will be the demands of your customers. The other will b

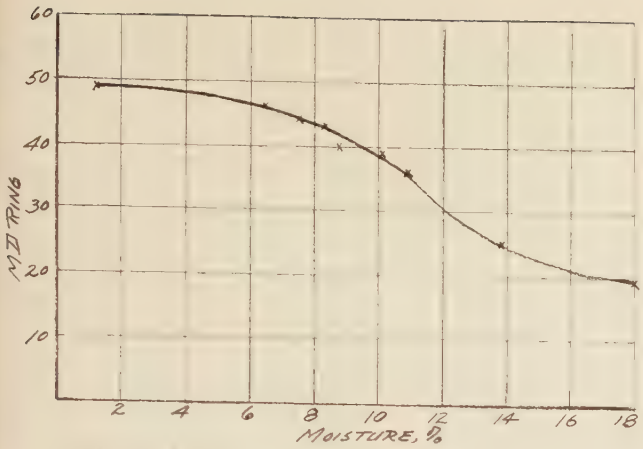


Fig. A-1. Straw (30 lb. per 1000 sq. ft.)

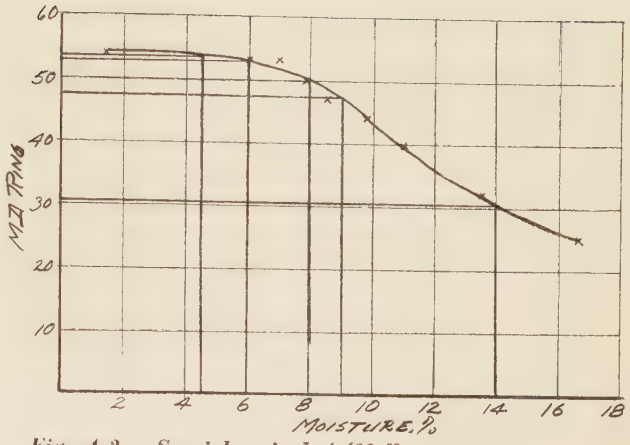


Fig. A-2. Semichemical A (28 lb. per 1000 sq. ft.)

the demands made by the condition of the monthly profit and loss statement.

Our evaluation will be solely concerned with the effects of moisture variation upon the results of the tests evaluated.

We recognize that the scope of the investigations made is insufficient to prove or establish any major new truth, and moisture does affect the results of tests of cellulosic products is an established fact.

When making the investigation we were only interested in the *extent* of change made due to moisture variation and the effect of such change upon test results. In the course of the investigation, particularly when collating the resultant data, information developed which seemed to us too important to ignore. This paper is, therefore, divided into two parts. Part I is a factual report of the investigation. Part II lists and discusses information that resulted from the investigation.

It is axiomatic that corrugated boxes are expected to protect their contents from the hazards that are normal to shipping, storing, and handling. Such hazards can vary greatly due to the demands of the contents. However, all boxes are expected to withstand the effects due to changes in relative humidity to which the boxes may be *reasonably* subjected.

Converting the information from the tests into a practical application, and using Fig. D-9 as an example, we find that:

For a box to be *strong enough* at	6%	8%	9%	14%	moisture content
it must be stronger than necessary at	5.2%	13.2%	10.7%	21.6%	
	4.5%	6.0%	8.0%	9.0%	moisture content
For a box to be *strong enough* at		8%	9%	14%	moisture content
it must be stronger than necessary at		17.8%	22.5%	30.0%	
		4.5%	6.0%	8 0%	moisture content
For a box to be *strong enough* at			9%	14%	moisture content
it must be stronger than necessary at			26.6%	39.2%	
			4.5%	6.0%	moisture content
For a box to be *strong enough* at				14%	moisture content
it must be stronger than necessary at				15.6%	
				4.5%	moisture content

Based upon information obtained from the graphs made of the test results obtained, we can readily see that in all cases tested, the results will be similar to the table immediately above. That is, that in order to have adequate strength present at a reasonably high humidity, the boxes must be much stronger at low humidity than would be otherwise necessary.

We did not set out to prove anything, merely to learn what would happen to test results as moisture content of the test specimen changed. We find that in all instances the loss in strength varies from one third to a little over one half, at the 14% moisture content point.

Because of the paucity of tests made our results cannot be considered general in application although the indication is that they would be so. Basing our conclusion only upon the particular boards evaluated, we find that a considerably greater loss in test value occurred in the "corrugating ($4^1/_2$ to 9% moisture content) range" due to increase in moisture content per cent with the flat crush test results, than occurred within the same range for the samples tested for ring compression. However, in the "SSH (9 to 14% moisture content) range" (shipping, storing, and handling), the loss in value of the flat crush test result was much less than the average loss for the samples tested by the ring compression test. Only

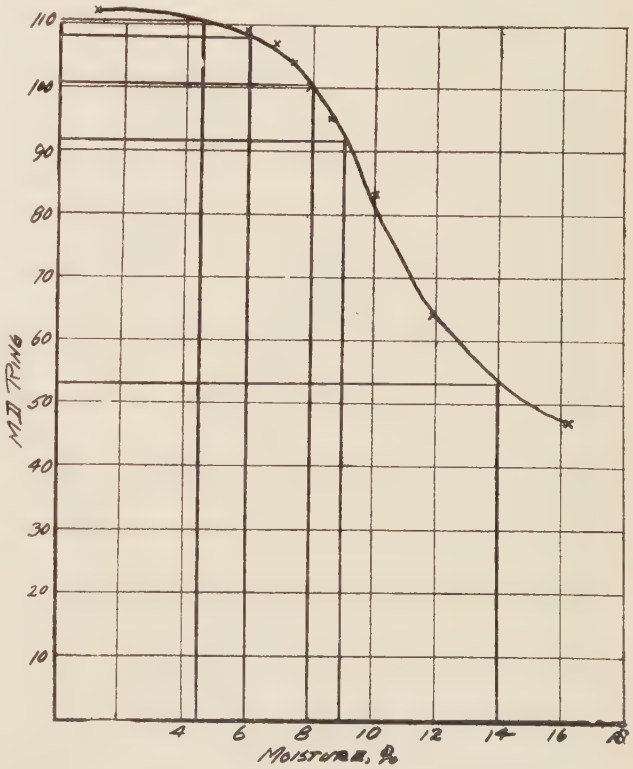


Fig. A-3. Semichemical B (36 lb. per 1000 sq. ft.)

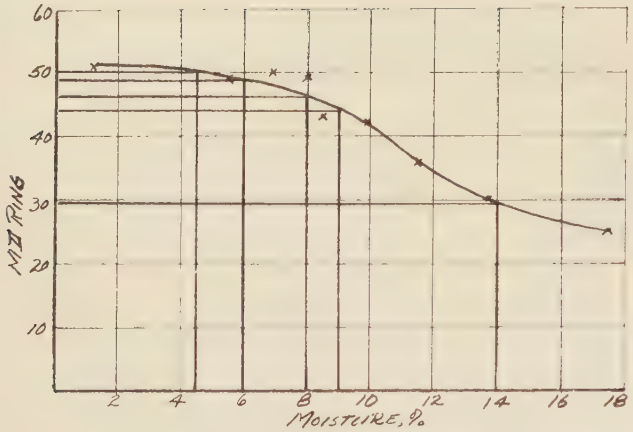


Fig. A-4. Kraft A (26 lb. per 1000 sq. ft.)

one of the ring crush tested samples compared favorably in this range with the flat crush tested sample. Without knowing, we believe this effect may be due to the use of some wet-strength resin.

The loss in test value that was sustained in the flat crush tests was much more uniformly distributed over the entire moisture range than occurred in the ring crush test results. The great drop in test value between 9 and 14% moisture content that appeared to be characteristic of the ring crush tests, did not occur with the flat crush test.

The single-fluter test results were much more like the flat crush than the ring compression test results, i.e. the decrease in test value was more uniformly distributed over the entire moisture range, the huge decrease in value above 9% moisture content did not take place.

The similarity of curves pictured by A, B, C, and D indicate a similarity both in the effect measured and in test results. A reasonably accurate comparison should be readily made. E, as denoted by the curves, is obviously different from the other tests, both in effect measured and in result. No further comparison of E, with the other tests investigated will be attempted at this time.

The results of most all of the series of tests made are combined in Figs. T1, T2, and T3. Figure T-1 pictures the actual loss in test value that occurred between each of the points we arbitrarily picked within the corrugating and within the shipping, storing, and handling ranges. Nine series of tests are shown, grouped at each of the specified moisture content percentage points. Figure T-2 pictures the

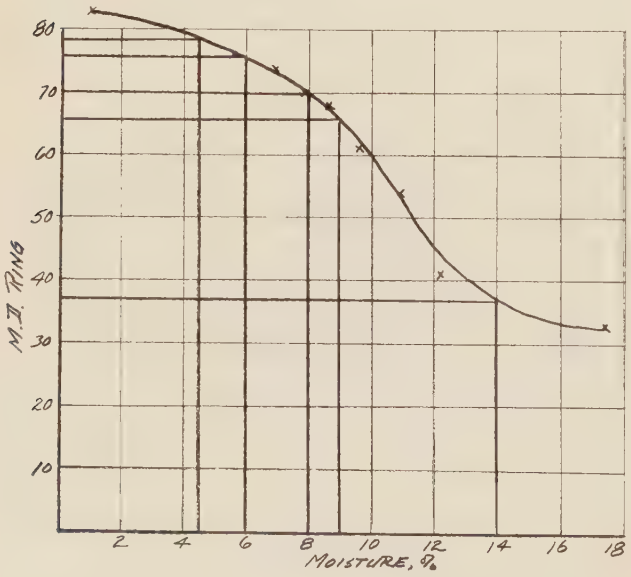


Fig. A-5. Kraft B (33 lb. per 1000 sq. ft.)

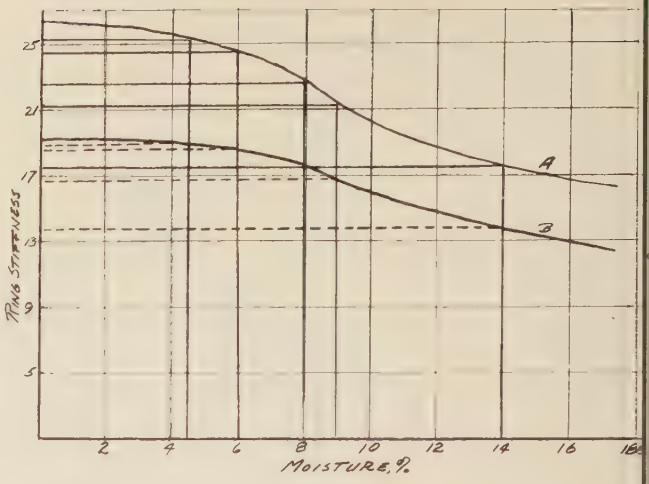


Fig. B-6

same information with the grouping by product tested rather than by moisture content percentage point. Figure T-3 portrays the changes that occur in relative moisture content and in relative test value at the different relative humidity points used in test A. A comparison of these charts can supply much useful information.

For example it is interesting to note that both the heavier semichemical and the heavier kraft sheets lost much more in test values than did the corresponding lighter weight sheets.

Therefore, we have shown conclusively that for the paper investigated, moisture has a decided effect upon standard corrugating test results.

APPENDIX

Some boxes can be filled with products that require cold storage, others may be stored for a considerable period in a damp area, either of which will have a higher-than-normal relative humidity. Fruits, vegetables, and many other products that dehydrate upon aging are now packed in corrugated boxes. Much of the moisture released by the content is absorbed by the box components, thus increasing their moisture content percentage.

So, while a relative humidity of 75 to 85% may be considered on the high side, it is, however a relative humidity to which a reasonable percentage of corrugated boxes will be exposed. At 75 to 85% R.H. the moisture content of the box components will probably be approximately 14%.

We hope that you will bear the foregoing in mind as you review the results of the tests we have made and evaluated.

The effect of moisture variation upon five different types o

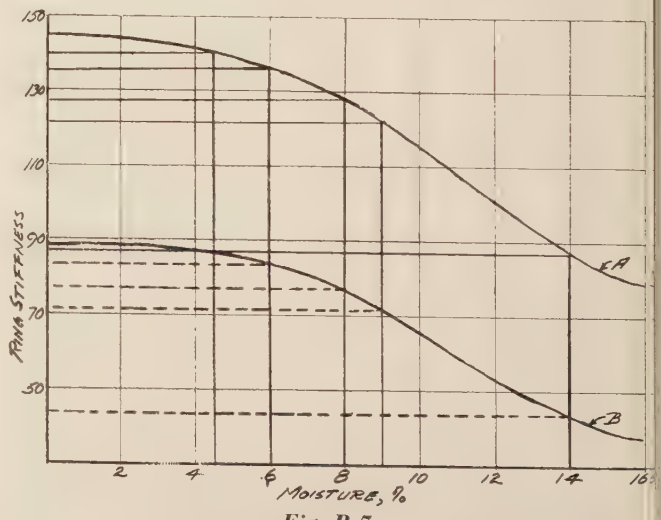


Fig. B-7

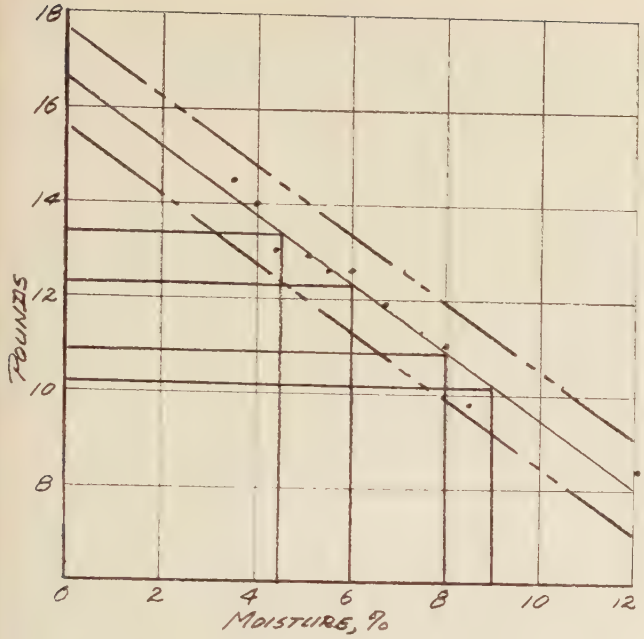


Fig. C-8. Single flute versus moisture

corrugating medium, test A, was studied in a group of tests using the H & D ring crush tester, sold by Testing Machines, Inc. of New York City. You can make your own observations from the data presented. First is a 30-lb. straw (A-1). You will note that the drop in the curve does not seem excessive within the preferred corrugating range and not unduly excessive going through what we shall call the storage range.

We find that there is a drop in ring stiffness of 47% at $4^1/_2$% moisture content to 41.5 at 9% moisture content. This amounts to a 12.7% decrease in crush resistance, which some people might consider more than a reasonable variation, some might not. At 14% moisture the crush strength has been reduced to 24.% which is only 51.6% of the crush at $4^1/_2$% moisture content. In terms of operating procedure and in terms of dollars and cents, this means that if the box, in which this medium is used, is to perform satisfactorily at 14% moisture content, it must have a ring measurement that will be twice as great as will be needed at $4^1/_2$% moisture content. In order for the box to be strong enough to withstand conditions that might be encountered during storage, handling, and shipping, a stronger, more expensive medium

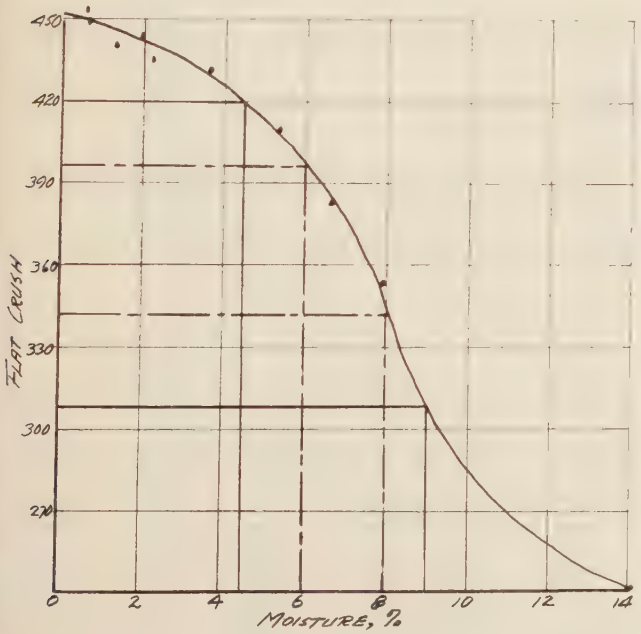


Fig. D-9. Flat crush versus moisture (C flute)

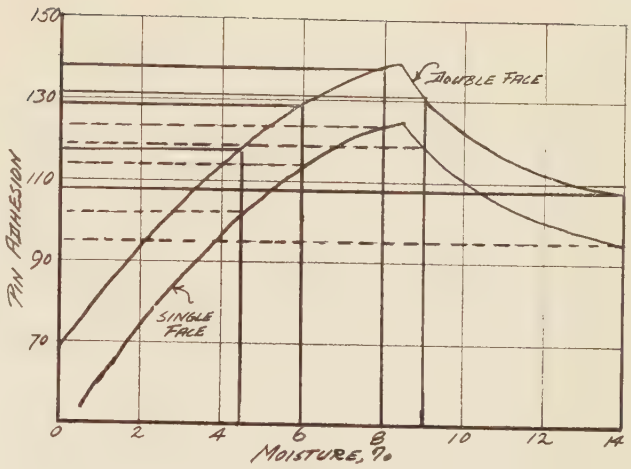


Fig. E-10. Pin adhesion versus moisture

must be used than would be needed if the maximum moisture content would not exceed 9%.

Next is a 28-lb. semichemical medium (A-2). You will note that in this instance the reduction in strength from 53.7 at $4^1/_2$% moisture content amounted to 6.2 at 9% moisture content and 30.5 at 14% moisture content. The strength at moisture content, as pictured by the ring test value, has dropped 18.5% and at 14% moisture content the strength has dropped to where it is only 56.8% of the ring stiffness shown at $4^1/_2$% moisture content. Figure A-3 pictures another semichemical medium. This is a heavier sheet, 36 lb., and makes a much greater drop percentagewise in the storage range, 48.2%, even though the drop throughout the corrugating range is a trifle less than that of the semichemical sheet previously shown.

Next is a 26-lb. kraft corrugating medium (A-4). Here the drop in ring crush resistance during the corrugating range was only 12%. In the storage range it amounted to 59.6%. This is higher than the figures maintained by the sheets previously shown.

Next comes a 33-lb. kraft corrugating medium (A-5). Within the corrugating range, A-5 loses but $3^1/_2$% more in test value than A-4. Yet during the storage range it drops down to 47.7%, nearly 12 percentage points lower than A-4.

The preceding five tests were done by John Little and Earl Knapp of the Hinde & Dauch Paper Co.

The next four curves, test B, were prepared by Russell L. Lewis and Charles Markee of The Ohio Boxboard Co. They approached the problem from quite a different point of view. They took a semichemical medium and a 0.016-in., 56-lb. jute. In each instance they compared the machine direction strength with the cross machine direction strength. In their evaluation they used a National Forge compression tester.

Figure B-6 shows the relationship between the machine direction and cross direction strength of the semichemical sheet, as shown by the ring test at the moisture content percentages which are standard for these experiments. You will note that in each of these curves a general line is followed, the "machine direction" curve being considerably higher in the lower moisture ranges than is the "cross the machine" curve. However, it may be significant that the drop in strength in the test made in the machine direction was considerably greater than the loss of strength in the cross machine direction. This was to be expected, but was it to be expected to such an extent?

Figure B-7 compares the change in ring stiffness in the jute sheet between the machine direction and the cross machine direction. The two lines are more nearly parallel than were the corresponding lines of the semichemical sheet, showing that the relationship between the two strengths is more nearly uniform. However, the loss of crush strength

of the jute sheet in both instances was much greater than the loss of strength exhibited by the semichemical medium.

Figure C-8 was prepared by K. R. Martin of the Fort Wayne Corrugated Paper Co. at Hartford City, Ind. You will note that the results are checked statistically. Those who understand will find much of interest in Mr. Martin's statistical calculations.

The instrument used here is a single-flute tester developed at The Institute of Paper Chemistry at Appleton, Wis. In this instance the drop in strength appears to make an almost 45° angle curve which is extremely unusual in this type of work. The loss of strength within the corrugating range was 37% and through the corrugating and storage range amounted to 42½%.

Figure D-9 is the flat crush versus moisture evaluation. It was made under the direction of Milton Yezek of the Carton and Container Div., General Foods Corp., Battle Creek, Mich. This is similar to the chart that is responsible for the other work that has been shown.

Figure E-10, prepared at the Dura-Glass Laboratories of the Owens-Illinois Glass Co., pictures the result of the pin adhesion test. This, as you know, is an attempt to measure the strength of the bonding of the corrugating medium to the liners. These people used the electro-hydraulic tensile tester, manufactured and sold by Thwing-Albert Instrument Co. of Philadelphia, Pa. You will note that this chart shows a definite peak at 8½% for both single-face and double-face corrugated board. The loss of strength on both sides of the point of maximum strength is very acute. Reasons for this abrupt drop might be important to evaluate.

It is not the function of those who cooperated in performing these experiments to draw any conclusion except that there is a definite change of characteristics measured by the testing procedures herein used which is believed due entirely to variation in the moisture content of the test specimens. How important that is to you and to your company depends upon you and your company. As stated above it will also depend upon your customers and upon your profit and loss statement. In many applications the use of proper test procedures has proved invaluable in increasing the efficiency and speed of production and decreasing markedly the amount of inferior merchandise that is produced.

Test A. Effect of Moisture on Ring Test

EARL KNAPP and JOHN LITTLE, *The Hinde & Dauch Paper Co.*

Five types of corrugating medium were used: A-1—straw; A-2—semichemical A, 28 lb.; A-3—semichemical B, 36 lb.; A-4—kraft A, 26 lb.; and A-5—kraft B, 33 lb.

Ten strips were cut ½ by 6 in. from the above mediums for testing at nine different conditions of moisture and randomized. Samples for moisture test were also cut.

Tests were made on samples dried over calcium chloride for 72 hr. and conditioned for 24 hr. at 80°F. and 35, 44, 50, 58, 66, 71, 83, and 91% relative humidity. The testing was done in the same room used to condition the samples. The samples used for moisture test were conditioned with the test strips and moisture calculated on the oven-dry basis. The ring test is reported in pounds—machine direction ring and the curves plotted with this value versus the oven-dry moisture. The test results are shown in Table A-1.

The equipment used was: H & D ring crush tester by Testing Machines, Inc., New York, N. Y.

Test B. Compression Test Results

RUSSELL L. LEWIS and CHARLES MARKEE, *The Ohio Boxboard Co.*

Types used were: B-6-a—0.009-in. semichemical corrugating medium, M.D. (½ by 2 in.); B-6-b—0.009-in. semichemical corrugating medium, C.D. (½ by 2 in.); B-7-a—0.016-in. 56-lb. Jute, M.D. (½ by 6 in.); B-7-b— 0.016-in. 56-lb. Jute C.D. (½ by 6 in).

Ring stiffness samples were cut from each of two different corrugated board components for this study. Sufficient samples were prepared to allow ten readings in each grain direction under four different moisture conditions.

The samples were preconditioned at 73°F., 35% R.H. for 2 hr., and then placed in humidity rooms under controlled atmospheric conditions of 73°F., 35 to 40% R.H.; 73°F., 50 to 55% R.H.; and 73°F., 80 to 85% R.H. for a period of 5 days. The samples were then tested for ring compression in the conditioned atmosphere using a National Forge compression tester. Square foot samples of the same board conditioned in a like manner, were tested for moisture content. An additional set of samples was placed in an oven at 220°F. and dried to a moisture-free basis for the fourth point.

0.009-in semichemical corrugating medium; ring stiffness (½ in. by 2 in.)			*0.016-in., 56-lb. jute ring stiffness (½ by 6 in.)*		
Moisture, %	*M.D.*	*C.D.*	*Moisture, %*	*M.D.*	*C.D.*
0	26.5	19.2	0	145	89
6.2	24.3	18.6	5.5	138	85
9.1	21.1	16.6	8.5	125	74
17.4	17.3	12.4	15.9	79	38

The test we have undertaken is known as the "compression resistance of paperboard" or more commonly termed "ring crush test." This test measures the resistance of paperboard to edgewise compression and is outlined in TAPPI Standard T 472 m-51.

The instrument used is the 750-lb. container testing machine, manufactured and sold by the National Forge & Ordnance Co., Warren, Pa. This instrument conforms to the specifications outlined in TAPPI Standard T 472 m-51.

Results obtained from this study agree generally with those of previous tests of this type. Although the use of four points to plot a curve is admittedly not a good practice, the general slope of the curve would appear to be correct.

Test C. Single Flute versus Moisture

K. R. MARTIN, *Fort Wayne Corrugated Paper Co.*

Tests were made to determine the effect of moisture upon single-flute crush strength.

Seventy single-flute specimens, 1 by 3 in. with the 3 in. length being the machine direction of paper, cut from a sheet

Table A-1. Effect of Moisture on Ring Test

	A-4		*A-5*		*A-1*		*A-2*		*A-3*	
Relative humidity, %	*Kraft A, 26 lb. M.D. ring*	*Moisture, %*	*Kraft B, 33 lb. M.D. ring*	*Moisture, %*	*Straw A, 30 lb. M.D. ring*	*Moisture, %*	*Semi-chemical A, 28 lb. M.D. ring*	*Moisture, %*	*Semi-chemical B, 36 lb. M.D. ring*	*Moisture, %*
Dried over calcium chloride	51	1.2	83	1.0	49	1.2	54	1.4	112	1.1
35	49	5.5	76	5.6	46	6.5	53	6.0	109	5.9
44	50	6.9	74	6.9	44	7.5	53	7.0	107	6.8
50	49	8.0	70	7.9	43	8.3	50	7.9	104	7.4
58	43	8.5	68	8.6	40	8.8	47	8.5	100	7.9
66	42	9.9	61	9.6	39	10.1	44	9.8	95	8.6
71	36	11.5	54	10.9	36	10.9	40	11.0	83	10.0
83	30	13.7	41	12.2	25	13.8	32	13.5	64	11.9
91	25	17.5	33	17.4	19	18.1	25	16.6	47	16.2

of semichemical, 26-lb. 0.009 corrugating medium. Fifty of these samples were used for forming single-flute specimens and the remaining 20 were used to measure moisture content. All samples were cut from a 12 by 24-in. area in an effort to hold variation between specimens to a minimum.

Equipment used was: single-flute corrugator, manufactured by the Fox River Tool Co., Appleton, Wis., for The Institute of Paper Chemistry; single-flute specimen holders; H & D compression machine, using 0 to 500-lb. beam, and a Federal precision dial gage which records in $^1/_{10}$-lb. increments; electric drying oven; Hart moisture meter.

Seventy single-flute specimens were cut, put in a box, and thoroughly mixed by shaking; and then, 50 were formed on the single-flute corrugator. They were then allowed to condition for a minimum period of 24 hr. in an atmosphere of 85°F., 80% R.H. The remaining 20 specimens were left unformed and were used for measuring moisture content.

After the conditioning period, moisture content was measured on two samples reserved for this purpose with the Hart moisture meter, and five formed specimens were crushed to determine the single-flute strength.

The unformed 1 by 3-in. samples were then placed in an electric oven (180°F.), one at a time, and were allowed to dry for periods of time ranging from 5 to 45 sec. at 5-sec. intervals. After each specific drying period, the samples were removed from the oven and moisture content measured immediately. The moisture content was measured on two specimens for each specific drying period and the average taken.

The formed specimens were then placed in the oven, one at a time, and allowed to dry for a specific period of time. They were then removed and immediately crushed on the H & D compression machine equipped with the special highly sensitive dial. Five samples were tested for each specific drying period.

The above information readily indicates that there is a definite influence of moisture on flat crush strength. It will be noted that the largest single drop for moisture content occurred during the first 5 sec. The greatest single increase in strength also occurred in the first 5 sec. After the first 15 sec. in the oven, the decrease in moisture content and the increase in strength were more constant for each specific drying time.

Table C-1

Time in oven, sec.	*Crush strength in, lb. per $^1/_8$ sq. in., av. of five samples*	*Range*		*Moisture content, %, av. of two samples*
		High	*Low*	
0	8.4	8.8	7.9	12.1
5	9.8	10.2	9.6	8.5
10	11.0	11.6	10.7	8.0
15	11.9	12.4	11.2	6.7
20	12.6	13.1	12.0	6.0
25	12.6	13.3	12.0	5.5
30	12.9	13.6	12.3	5.1
35	13.0	13.6	12.7	4.4
40	14.0	14.5	13.6	4.0
45	14.5	14.9	14.0	3.5

Graphs showing the plottings of single-flute strength versus moisture, the line of regression best fitting the points, and the lines designating the three sigma limit spread from the regression line are given. The data and calculation sheet for linear correlation accompany the graph.

Two series of tests were made on different week ends in an effort to determine if the results are reproducible and if the same correlation existed. The correlation for the two different groups came out identical, being a -0.98. The slope for one group was -0.75, for the other group -0.71, and the y axis intercepts were $+16.23$ and $+16.60$. The standard deviation was 0.36 for one group and 0.355 for the second group. This paper is on the secnd group of tests.

Conclusions

1. The correlation between moisture and single-flute strength was very high. r^2 (step 31 on data sheet) indicates

Table C-2. Data and Calculation Sheet for Linear Correlation

% X.	Y, lb.	Coded X	Coded Y	X^2	Y^2	XY	Step	Operation	Calculation
12.1	8.4			146.41	70.56	101.64	1	ΣX	63.80
8.5	9.8			72.25	96.04	83.30	2	ΣY	120.70
8.0	11.0			64.00	121.00	88.00	3	ΣX^2	467.42
6.7	11.9			44.89	141.61	79.73	4	ΣY^2	1,488.44
6.0	12.6			36.00	158.76	75.60	5	ΣXY	727.31
5 5	12.6			30.25	158.76	69.30	6	N	10
5.1	12.9			26.01	166.41	65.79	7	1+6	6 $38\bar{X}$
4.4	13.0			19.36	169.00	57.20	8	2+6	12.07$\bar{Y}$
4.0	14.0			16.00	196.00	56.00	9	4+6	148.84
3.5	14.5			12.25	210.36	50.75	10	1^2	4,070.44
							11	1×2	7,700.66
63.80	120.70			467.42	1488.44	727.31	12	2^2	14,568.49
							13	3×6	4,674.20
							14	13−10	603.76
							15	4×6	14,884.40
							16	15−12	315.91
							17	5×6	7,273.10
							18	17−11	−427.56
							19	14×16	190,733.82
							20	$\sqrt{19}$	436.73
							21	18+20	$-0.98r$
							22	18+14	$-0.71m$
							23	7×22	−4.53
							24	8−23	$16.60b$
							25	Choose X	4 11
							26	22×25	−2.84 −7.81
							27	24+26	$13.76Yc$ $8.79Yc$
							28	8^2	145.68
							29	9−28	3.16
							30	$\sqrt{29}$	$1.7776\sigma y$
							31	21^2	0.96
							32	1−31	0.04
							33	$\sqrt{32}$	0.2
							34	30×33	$0.355Sy$
							35	27+3 34	14.83 9.86
							36	27−3 34	12.69 7.72

that we have accounted for 96% of the variation, as measured by these tests.

2. Standard deviation equals 0.355.

3. Plus or minus two standard deviations control limits cover 90% of all observed group tests.

4. Plus or minus three standard deviations control limits cover 100% of all observed group tests.

Test D. Flat Crush

MILTON YEZEK, *Carton & Container Div., General Foods Corp.*

Ninety-one flat crush specimens were cut from the same sheet of corrugated board and within the smallest area possible to reduce the variability between specimens to a minimum.

The 91 specimens were placed in a humidity cabinet at 100°F. and 88 to 92% R.H. for a period of 14 hr. After this period the specimens were placed into a closed metal container and were allowed to temper for 1 hr. Seven specimens (5 for flat crush; two for moisture) were placed in an oven (100°C.) for each drying period. Each group of seven specimens was placed in the oven with the flutes aligned in one direction so as to attain uniform drying through a continuous flow of forced air between flutes. After each specific drying period, each set of specimens was placed in a small closed container and allowed to cool and temper for 20 min. Flat crush was then determined on five specimens and moisture was determined on the remaining two specimens.

Table D-1

Time specimens in oven, sec.	*Flat crush, av. of five specimens*	*Moisture, %*
0	240	14.4
25	309	9.0
50	353	7.9
80	383	6.6
90	410	5.3
150	432	3.6
180	435	2.2
200	440	1.3
240	444	1.95
330	449	0.63
480	454	0.60
660	459	..

From the above data and curve the influence of moisture has on flat crush (H & D crush tester) evaluation can readily be seen.

Corrugated board coming off the corrugator is not subject to the extremes of moisture as depicted by the study, however, the range is large enough to produce erroneous conclusions based on flat crush values obtained on samples directly from the corrugator.

The rate of moisture loss of a specimen with high moisture content is very rapid at the beginning as can be seen by the steepness of the initial part of the curve (moisture versus drying time). The rate decreases as zero moisture is approached.

Test E. The Effect of Corrugated Board Moisture on the Pin Adhesion Test Results

DURAGLASS CENTER, *Owens-Illinois Glass Co.*

One hundred and twenty specimens of corrugated board were cut from one sheet, size 48 by 60. These specimens were cut to 9½ in. long by 2 in. with the corrugations running the 2-in. way. This specimen size was sufficiently large to permit a test of the adhesion on the single-face and a test of the adhesion on the double-face side of the specimen. The corrugated board used was made with 42-lb. fourdrinier kraft liners and semichemical 26-lb. corrugating medium and bonded with starch.

Ninety-one specimens were placed in a humidity cabinet at 100°F. and 85 to 93% R.H. for a period of 16 hr. After this time, the specimens were placed in closed metal containers and were allowed to temper for 1 hr. Seven specimens (five for the two pin adhesion tests and two for determining moisture) were placed into an oven at 100 to 110°C. for each drying period. Each group of seven specimens were placed in the oven with the flutes aligned in one direction so as to attain uniform drying through a continuous flow of forced air through the flutes. After each specific drying period each set of specimens was placed in a gallon-wide mouth bottle closed with a metal closure and allowed to temper for 20 min. Pin adhesion was then determined on five specimens and the moisture was determined on the remaining two specimens.

The remaining specimens were placed in the humidity cabinet when the ninety-one were removed. The specimens that were placed in the humidity cabinet when the ninety-one were taken out, were removed at 2½ hr., 4½ hr., and 5 hr. The first two sets were tested after tempering for 1 hr. in glass jars and the last one was tested after being in the laboratory atmosphere of 73° and 51% R.H. for 1 hr. The idea back of this was to have additional specimens on hand if the original data did not yield sufficient information to properly evaluate the relationship.

To determine the per cent moisture in the specimens reserved for that purpose, we used the method outlined in the note at the bottom of TAPPI Standard T 412 m-42.

Listed below are the per cent moisture and the test results on the single-face side of the board and on the double-face side of the board. You will notice from the curve that there is an increase in the pin adhesion as the moisture increases up to approximately 8½%. After the moisture has reached 8½%, it begins to decrease and we would assume that the decrease would continue to zero.

Moisture, %	*Single face results*	*Double-face results*
13.03	97.6	110.5
10.30	102.0	116.0
10.25	100.4	116.0
8.48	124.8	139.4
6.78	116.0	128.6
6.56	119.8	129.0
4.32	109.4	119.8
4.02	87.4	110.8
2.76	73.4	93.8
1.71	71.8	84.0
1.26	58.6	87.4
0.93	58.6	82.6
0.60	58.2	73.6
0.56	56.2	76.4

The results of this initial study are very interesting to all those who have anything to do with the bond of corrugated board. We do not feel, however, that this study is complete. We believe that additional work should be done to see if this same type of curve develops when the missing moisture percentages have been filled in. We also wonder whether this same type of curve will be maintained when the type of liner, corrugating medium, and adhesive are changed.

Equipment used was: electro-hydraulic tensile tester model 35-4, Thwing Albert Instrument Co., Philadelphia 44, Pa.

The Effect of Moisture Variation upon Standard Corrugating Test Procedures—Part II

WE CONSCIENTIOUSLY tried to make Part I of this paper a purely factual report of observations made while preparing and collating the material for the paper. In Part II we respectfully call your attention to some matters that also came to our attention while preparing Part I. Perhaps, strictly speaking, they should not be included in this report. How

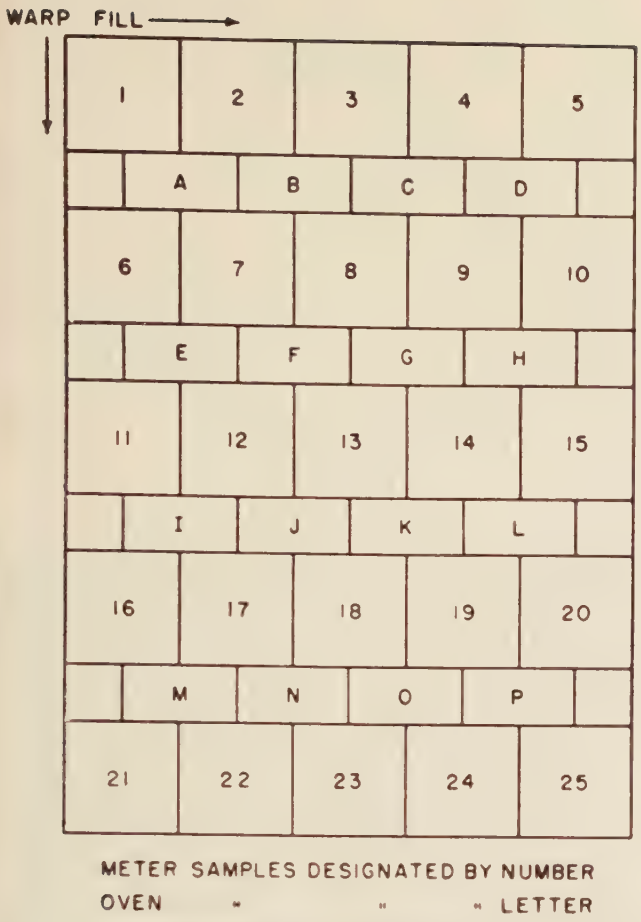


Fig. F-1. Sample pattern for fabric used in oven and meter tests

ever, they are all closely related to our subject and seemed too important to ignore. They could well become subjects for future papers.

Most of the items noted pertain to corrugating operations. Many of these also apply to other converting operations and to papermaking as well. Some will apply particularly to papermaking but will also be discussed.

Whether or not you make tests, their extent, and the use made of test results is one of your problems, not one of our problems. We do believe that if tests are made and used that they should be made and used correctly. To be of value, any test must simulate with reasonable practicality the characteristics which the test is intended to evaluate. If the test procedure can be readily made and the test result readily understood, that is to be preferred. However, it is a matter of greatest importance that the test accurately portray the effect that the test is supposed to picture or measure. It is likewise important that the approved testing procedures be followed with the degree of precision demanded and that the test faithfully reproduce correct findings.

In the course of our investigation of the effect of variations in moisture content upon standard corrugating test procedures, we had cause to question whether some tests truly and correctly picture that property which they are intended to interpret. We did not investigate further. Therefore, we are not certain whether this was caused by the techniques used, improper interpretation of test results, a change in the concept upon which the test was based, the use of some raw materials other than those used when the test was set up, the need for greater precision than was originally contemplated for the test, the test being used to evaluate properties other than originally intended, the present need for closer correlation between test result and performance, and so forth.

We do feel, however, that it may be wise to re-evaluate some of the tests in current usage to be certain that the information supplied by tests is actually what it is believed to be.

As a rule, samples are picked at random, cut to convenient size, and are taken from areas that are hoped will picture a true condition of the sheet. We know of no other standard procedure. (See TAPPI Standards T 400 m-49 and T 402 m-49.)

The evaluation of a sampled product is based upon the results of tests made upon the samples. Therefore, the samples must present a true picture, both analytically and proportionately, of the product they represent. If not, the test results cannot only present a distorted picture, they may well show a false picture. Then test results can well be correct for the sample and at the same time be incorrect for the sampled product. Decisions based upon such evidence will probably be faulty.

In addition, it is mandatory that the samples remain truly representative of the sampled product until the tests are completed, or until the need for true representation is passed. Otherwise, one may have a true picture of the condition of the sample at the time the test was made. By then if proper care is not exercised, conditions in the sample can be quite different from conditions in the sampled product. This can, and sometimes is, the basis for erroneous conclusions. Under certain conditions some samples change faster than is often believed possible.

A few years ago a serious work was undertaken at the research department of a leading university to determine the best, most effective, and the most accurate method to measure moisture in textiles. This work was sponsored by a nonprofit, industry-wide, research organization. Three highly trained researchers each spent $2^1/_2$ years making this study. Six papers describing their work and their findings were presented and published.

Most textiles, as well as most papers, are largely cellulosic materials and have many problems in common, such as moisture variation, lack of uniformity across webs, rapid change in the moisture content percentage of test samples, etc.

These investigators discovered an "over-all" sampling pattern which proved extremely useful to them when making comparisons. It may prove helpful to others. It is pictured on Fig. F-1.

This "over-all" pattern was intended for comparatively narrow webs (less than 48 in.). However, many advantages of periodically extending this pattern across a paper web or sheet appear obvious. Many apparent discrepancies in test results might thus be eliminated through either random or periodic selection of samples which would then be converted into subsamples according to a definite plan. In describing this sampling procedure the author states:*

"*Sampling Procedure.* Meter measurements were made at predetermined positions in the fabric samples as shown in Fig. 1. There are 16 oven test positions and 25 instrument test positions.

"No complication from this pattern arose in analysis of variance, but for separation of variance components it was necessary to pair adjacent meter and oven subsamples. This pairing was accomplished by the discarding of one row of meter readings (along the filling) and one column of meter readings (along the warp), leaving sixteen meter readings to correspond to the sixteen oven subsamples. The method of selecting the row and column to be removed was by the use of random numbers. Studies were made of the effect of removing different rows or columns and it was concluded that the results were not generally sensitive to the particular group of subsamples removed."

A comparison of the foregoing with standard sampling procedures could well make an interesting and instructive paper. It could well be coupled with an investigation of methods to prevent sample change. Some, now in use are preferred by

* John C. Whitwell, "Estimating Precision of Textile Instruments," *Biometrics* 7, No. 1 (1951). Presented before the American Statistical Association annual meeting in Chicago, 1950, at sessions held jointly by the Biometric Section of the American Statistical Association and the Biometric Society, ENAR.

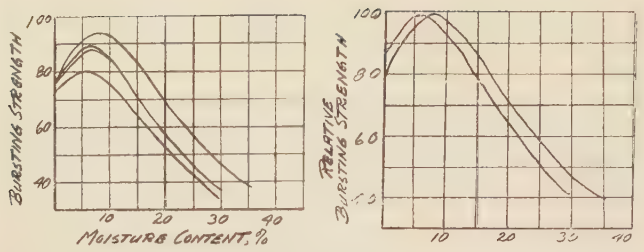


Fig. G-1. (Left) Bursting strength-moisture content relation. (Right) Relative bursting strength-moisture content relation

the users to T 400 m-49 and to T 402 m-49. Any procedure which would assure the selecting of more truly representative samples would simultaneously assure that the result of tests made upon those samples would likewise be more truly representative of the material being evaluated. Would not the use of a standard "over-all pattern supply a more accurate picture of existing conditions than the commonly used "front-center and back" method in general use? Would the cost of using the suggested method be more than the cost for using the present method? If so, would the results improve sufficiently to warrant such extra expenses?

We do not know whether the variations in results between the test procedures reported in Part I are due to differences in the stocks evaluated, to coincidence, or to the tests themselves. It may well be both interesting and valuable to determine whether variations in the curves that picture these investigations are truly representative of test results obtained when the different instruments are used—and if so, to see which instrument most clearly pictures what actually takes place in finished corrugated boards and boxes.

In all tests investigated the loss in test value that was incurred when increasing percentages of moisture were present, seemed excessive. This clearly shows that (if test results accurately picture what actually occurs in finished corrugated boards and boxes) in order to adequately protect box contents at a reasonably high moisture content, the boxes must be much stronger than necessary in the lower moisture content range. More expensive components are thus required than should be needed.

We know of a corrugated box made for a noodle and spaghetti manufacturer. The box contents are so light that great stacking strength was not considered necessary, yet the boxes tested well above the average required. The customer reported that the boxes not only wouldn't stack properly, but piles were falling all over his warehouse. Samples of this shipment were returned to the corrugated box manufacturer—they tested as satisfactory but the piles in the warehouse were still falling. Boxes that had buckled under light load were returned to the box manufacturer. They also tested satisfactorily. Someone took a swing hygrometer to the warehouse. The relative humidity was very high. Tests made upon boxes in the warehouse were very poor. In the presence of the high relative humidity, the otherwise excellent corrugated box was not satisfactory for the purpose intended. Had the boxes in this shipment been sample tested over a range of relative humidity prior to shipment, all that difficulty would have been avoided.

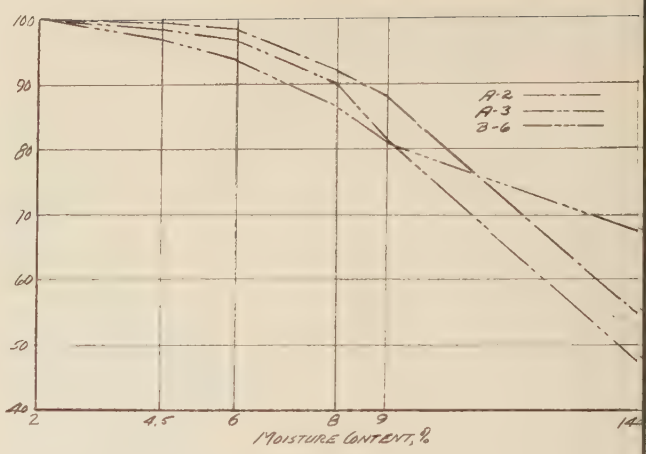


Fig. G-3

The pin adhesion test (E) is usually considered to be an indication of the strength of the adhesive bond, which may or may not, be correct. If fiber is generally "pulled" when the liner and medium are separated in this test is the adhesive failing? Or are one, or both, of the components separating? Is the pin adhesion test really a test of the adhesive bond or of the "matting" strength of the paperboards? Is the effect that is measured by the pin adhesion test similar to the effect that is measured when the Denison wax or scotch tape tests are applied to surface sized or coated fine papers?

The definite strength peak, as shown in E, is definitely reached at $8^1/_2$ for both single-face and double-face board. The loss of strength on both sides of the maximum point is acute. Sure knowledge of the reasons for this rapid drop might supply much useful, helpful information. A comparison of results of pin adhesion tests made upon standard components and wet-strength components, but which are otherwise similar might indicate just what property is really being measured when the pin adhesion test is used.

It was probably as natural as Nature's Law of Evolution for the original paper tests and test procedures to have been developed by laboratory and technical men for laboratory and technical men. Who else, in those days, wanted a standard more precise and unchanging than the trained arts and skills of the workers?

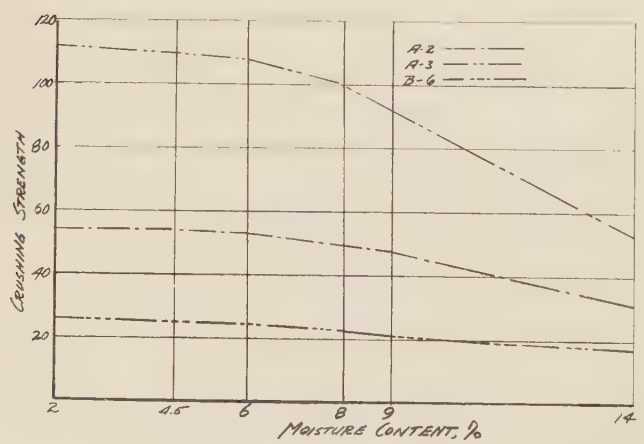


Fig. G-2. Ring compression versus moisture content

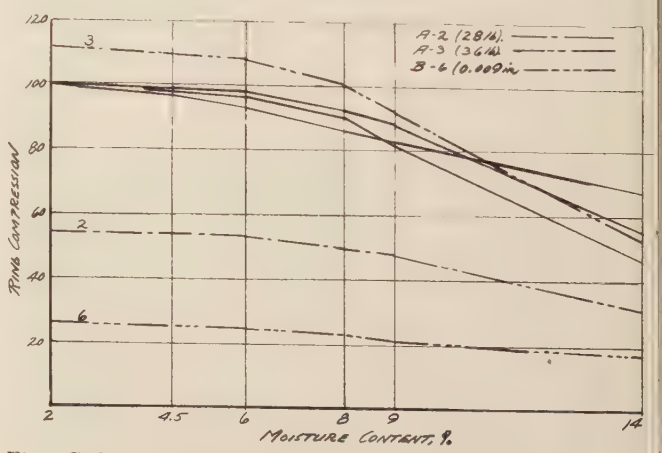


Fig. G-4. Relative ring compression-moisture relation versus ring compression-moisture relation

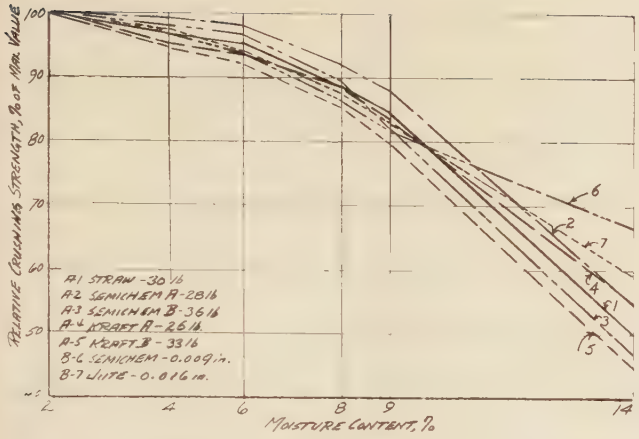

RELATIVE CRUSHING STRENGTH, % OF MAX. VALUE
MOISTURE CONTENT, %
A1 STRAW - 30 lb
A2 SEMICHEM A - 28 lb
A3 SEMICHEM B - 36 lb
A-4 KRAFT A - 26 lb
A-5 KRAFT B - 33 lb
B-6 SEMICHEM - 0.009 in.
B-7 WHITE - 0.016 in.

Fig. G-5. Relative ring compression versus per cent moisture (2%) through 14% moisture content

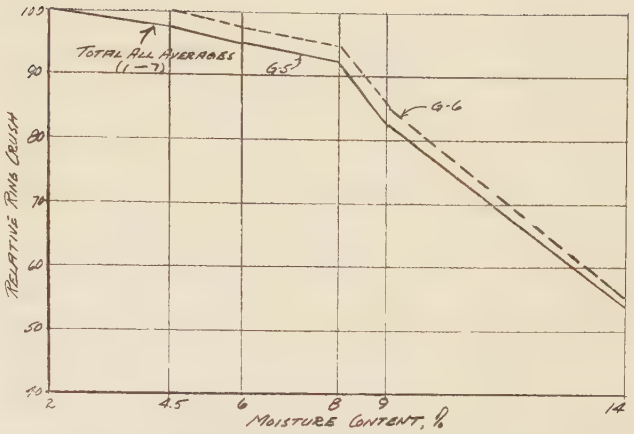


Fig. G-7. Relative ring crush versus moisture content. Average of Fig. G-5 versus average of Fig. G-6

The Law of Evolution continued to function. Today, in many mills and plants, it is probably top management that is most interested in tests and testing procedures. They are not necessarily interested in tests and test results *per se*, but are interested in maintaining a degree of quality, and particularly a degree of uniformly high quality. In many mills and plants, this cannot be maintained with only the old methods. Effective, efficient production controls and fully automatic controls seem to many as the solution of this problem.

Many of the early laboratory tests and test procedures are still in general usage, testifying to the intelligence, farsightedness, and perspicacity of the men who devised them. Many feel that there is now a growing need for tests to serve as production controls for which purposes the splendid laboratory tests are not necessarily effective.

The time, care, and precision that accompany laboratory testing are generally not realistic when transferred to station testing. It may well be that, should tests be re-evaluated in terms of current needs and conditions, testing techniques and procedures should also be investigated. For example: accuracy to one tenth of 1% is difficult to maintain under favorable laboratory conditions. To many it is ridiculous to be concerned with accuracy of less than one quarter, or maybe one half a per cent for production control work. After all, what degree of precision is uniformly maintained in a backtender's thumb (which is today's competition for some of the new production control instruments)?

What do you want in a production control test? Reasonable accuracy and precision? What is reasonable? What would you suggest for tolerances? A quick, true answer? Something that will help your operators to compare their present production with past performance or a standard? What else? The requirements for a production control test could be quite different than for a laboratory investigation. Would it be desirable to your operation if a set of production control test procedures was promulgated?

There are many tests for measuring the many properties of paper and paper products. However, no true comparison can be made of test results unless the test specimens being compared are at the same moisture content at the time the tests are made, as per TAPPI Standard T 402 m-49. It is not that the moisture content, or even variation in moisture content, is so important of itself. The importance of moisture lies in its effect upon the many other properties of paper and paper products. Most all these properties are affected by variations in moisture content. However, the relationship from one property to another will not necessarily vary in ratio to the variation in moisture content that might occur. In fact, there is now no known means of comparing even the same property at different moisture contents unless the samples being compared are brought to like moisture content and then evaluated.

Trying to compare the results of paper tests without first bringing samples to a common moisture content is like trying to add fractions with different denominators. Bringing the test samples to uniform moisture content is like reducing fractions to a common denominator. It supplies a common ground without which a comparison is not possible.

Approved TAPPI procedure, T 402 m-49, calls for test specimens to reach equilibrium with a controlled atmosphere of 50% R.H. and temperature of 23°C., and to do so on the *ad*sorbed rather than the *de*sorbed side which should not take less than 2 hr.

This procedure might be highly satisfactory as a laboratory technique, but it is completely unrealistic as a production control. Too much improper material can be produced during the period in which the sample is reaching equilibrium.

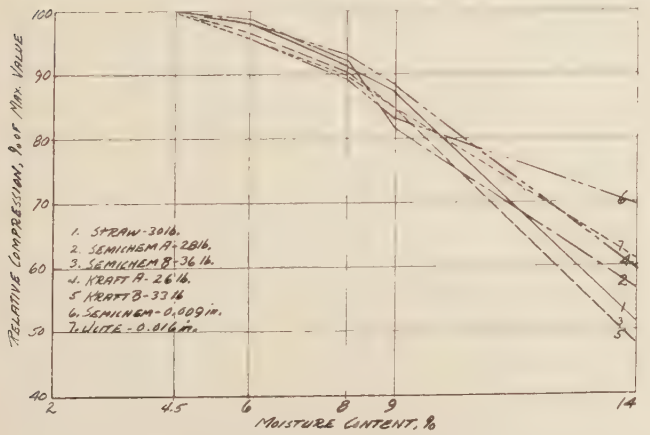

RELATIVE COMPRESSION, % OF MAX. VALUE
MOISTURE CONTENT, %
1. STRAW - 30 lb.
2. SEMICHEM A - 28 lb.
3. SEMICHEM B - 36 lb.
4. KRAFT A - 26 lb.
5. KRAFT B - 33 lb.
6. SEMICHEM - 0.009 in.
7. WHITE - 0.016 in.

Fig. G-6. Relative ring compression versus moisture content (4.5%) through 14% moisture content

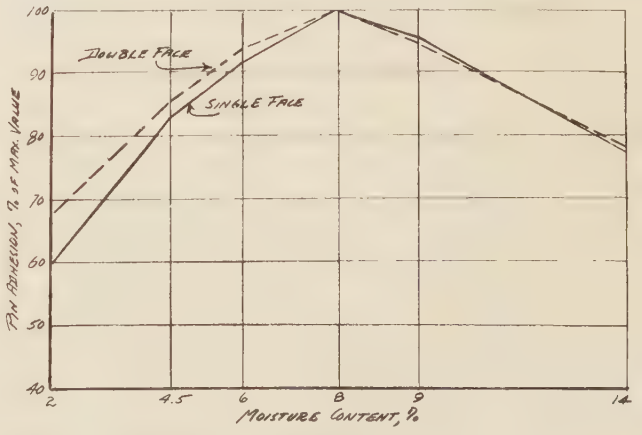


Fig. G-8. Relative pin adhesion test versus moisture content

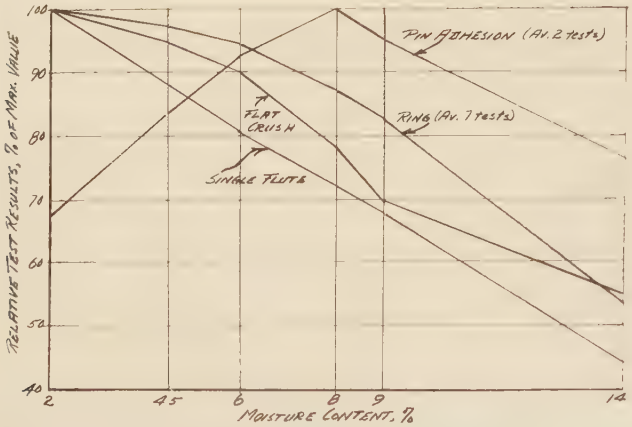


Fig. G-9. Consolidated relative test results of four different tests (test result—moisture content relationship)

One attempted means of eliminating this difficulty has been through the use of the hot oven-hot plate type of drying equipment. This will enable a moisture measurement to be made promptly, but is not the answer to the problem. The problem is not to just know the moisture content of the test sample, the problem is to bring the test sample to a specified moisture content quickly enough. Until such procedures have been properly devised there will be no way for a man on a paper machine or a corrugator on any other type of paper working equipment to gage the quality of his production. We know of no method whereby an operator can make a comparison of the quality of his production with a previously established standard. Without such method, there seems to be no possibility of developing accurate production controls, automatic or otherwise. It appears to many that one of the most important contributions that could be made by any one or any group to the paper industry will be the development of a means to measure the quality of the material he is producing as it is being produced.

In the course of our searching the literature for background information for this present report, we came upon "Effect of Relative Humidity on the Moisture Content and Bursting Strength of Four Container Boards," by C. O. Seborg, R. H. Doughty, and P. K. Baird, Forest Products Laboratory, Forest Service, U. S. Dept. of Agriculture, Madison, Wis.

This paper was first presented at the fall meeting of TAPPI at Appleton, Wis., in September, 1933, and was later printed in the *Paper Trade Journal* of Oct. 12, 1933, a little over 20 years ago.

In the course of other studies, these investigators found that curves measuring changes in burst strength due to variation in moisture content could be quite different. However, when the points upon which the curve is based are changed from picturing the actual strength measurement to picturing the percentage of maximum value, similar curves were produced as will be noted from Fig. G-1. The figure on

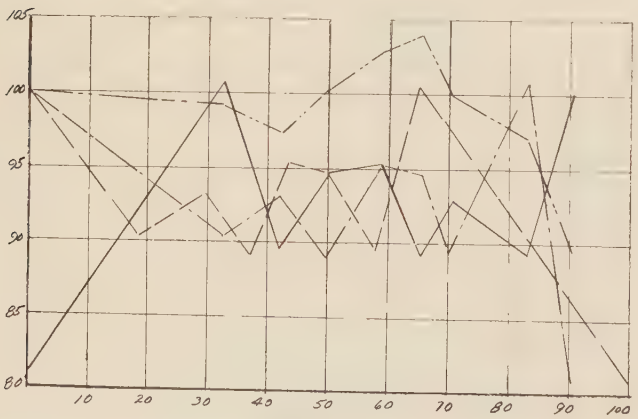


Fig. GX

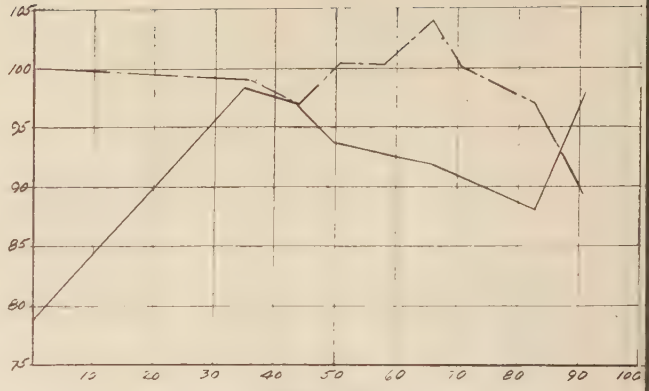


Fig. GY

the left(A) presents the bursting strength–moisture content relation. In both charts, lines O, P, and C represent jute board. Line F represents a kraft liner. You will note that there are definitely four curves. The graph on the right (B) pictures the *relative* bursting strength–moisture content relation. You will note that in B the three jute sheets are now represented by a single line and the kraft sheet by a line that is almost parallel.

Concerning this, the authors state:

"The bursting strengths and the relative bursting strengths are plotted against the moisture content of the samples in Figs. 5 and 6, respectively. The maxima in the curves are much sharper here than in the two preceding figures. The absence of experimental points at the maxima is quite as serious here as in the other curves.

"The kraft sheet reaches its maximum strength at a somewhat higher moisture content than do the others (8% as against 6%). By displacing the curve for the kraft sheet (sample F) in Fig. 6 to the left by 2% throughout its length, it is brought into very good agreement with the other curves. This suggests that all sheets fall off from their bursting strength maximum at the same rate with change of moisture content. If this is true it might be possible, knowing the moisture content at maximum strength, to predict the strength of the sheet at any moisture content."

Should this be true, these gentlemen then might have the key that would provide the means—that would give the machine operator the tool described above. Accordingly, we were interested in seeing what would happen if we followed the suggested procedures. Only reported was the burst test–moisture relationship. Also, they only reported on four sheets, three of which were very similar, and the fourth not too dissimilar.

Accordingly, we decided to see what would occur if we followed the suggested techniques, but applied them to the tests reported in Part I of this paper.

Burst test results increase as the moisture content increases until, at the proper moisture content (generally between 5% and 10% moisture content) they fall off from their maximum strength, forming an inverted U curve.

The crush tests, which formed the major portion of Part I, formed curves of a very different shape. These curves begin at their maximum, and fall off. Not having any suitable bursting strength curves at hand, and impressed with the po-

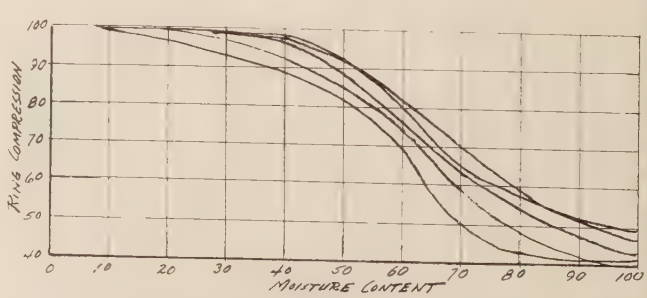


Fig. GZ. Relative ring compression versus relative moisture content

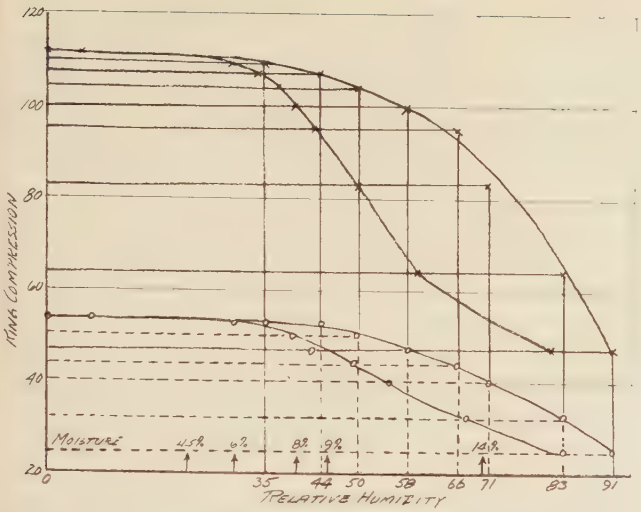


Fig. H-1. Ring compression-relative humidity relationship

tential importance of what might develop, we proceeded with the data at hand.

As in Part I, we were primarily interested in the "preferred corrugating range" (6% moisture content to 8% moisture content), the "working corrugating range" ($4^1/_2$ moisture content to 9% moisture content),and in the "storage" range (up to 14% moisture content), the figures being arbitrarily decided upon. The moisture content readings were taken from the charts used in Part I. Also, when the data were available, we planned to make some comparisons as low as 2% moisture content, which seems the minimum moisture content possible to encounter in actual operation. One comparison was also to be made at the lowest moisture content available.

These were all to be "pencil" comparisons, using the data from Part I. No actual experimental work was contemplated. The procedure followed was to be our understanding of the procedure mentioned in the report. (Lines connecting the plotted points were used instead of curves to make the comparisons more obvious.)

Figure G-2 pictures the ring compression–moisture content relationship. Like the authors, this first comparison was to be limited to the same kind of stock, in this case three of the semichemical sheets. You will note that at 2% moisture content, the spread between the lines is from 26 to 112, 86 points. At 14% moisture content the spread is from 17.5 to 53 or 35.5 points. At 8% moisture content the spread is from 23 to 100 or 77 points.

Figure G-3 pictures the *relative* ring compression–moisture relationship. Based points were the same except that they were shown in percentage of maximum value rather than the conventional figures. The lines spread out from the point for the 100% maximum. At 8% the spread was from $86^1/_2$ to 92 or $5^1/_2$ points. At 14% the spread was from 47.5 to 67.5 or 20 points. The spread between points, even at the widest, is much less on Fig G-3 than on Fig. G-2.

The line for B-6, from 2 through 8%, was in about the same relationship between the lines for A-2 and A-3. At 8%, B-6 became somewhat erratic compared to A-2 and A-3, each of which made almost regular arc curves. It should be noted that B-6 was originally plotted from four points, A-2 and A-3 each from nine points. The two A test specimens were $^1/_2$ by 6-in. strips while the B specimen was a $^1/_2$ by 2-in. strip. The tests were performed by different men on different equipment. We have no information concerning the three different papers except what is mentioned in the report. However, we do know that the A and B samples were made by different mills.

Some of the above might explain the different patterns of the A-2 and A-3 as against B-6. It does not explain why A-2 and A-3 did not form one line as the three bursting strength curves did in Fig. G-1-B. Curve A-2 with like values at two points might be a contributing factor. You will also note that on G-3, the distance between the lines becomes greater as the moisture increased, just as it did in the paper by Seborg, Doughty, and Baird.

Figure G-4 is a composite of G-2 and G-3. The dotted lines represent the actual values (G-2) and the straight lines represent the relative values (G-3). Note that on G-4 the "relative values" lines appear much closer together than on G-3, because of the forced contraction due to the smaller scale used on G-4.

These results seemed quite encouraging even though lines A-2, A, and A-3 were not identical as in the original work. They did not appear to be falling into the single line prediction made by Seborg, Doughty, and Baird, but they were close. What would happen if materials of different types were pictured in the same manner? The answer is in Fig. G-5, in which is shown most all the sheets used in this series. This includes one straw and three semichemical, two kraft and one jute. In each instance, tests were performed by different people in different plants on different papers on different equipment and under different circumstances. Yet, it will be noted that again all lines are in close relation one with the other, even though we did not plot curves—merely connected the plotted points.

Figure G-6 pictures the same papers, same measurements, same relationships as in Fig. G-4, except that in this instance we have limited the measurements to the corrugating range and the storage range only. In order to do this, we started with the maximum at $4^1/_2$% moisture content and refigured

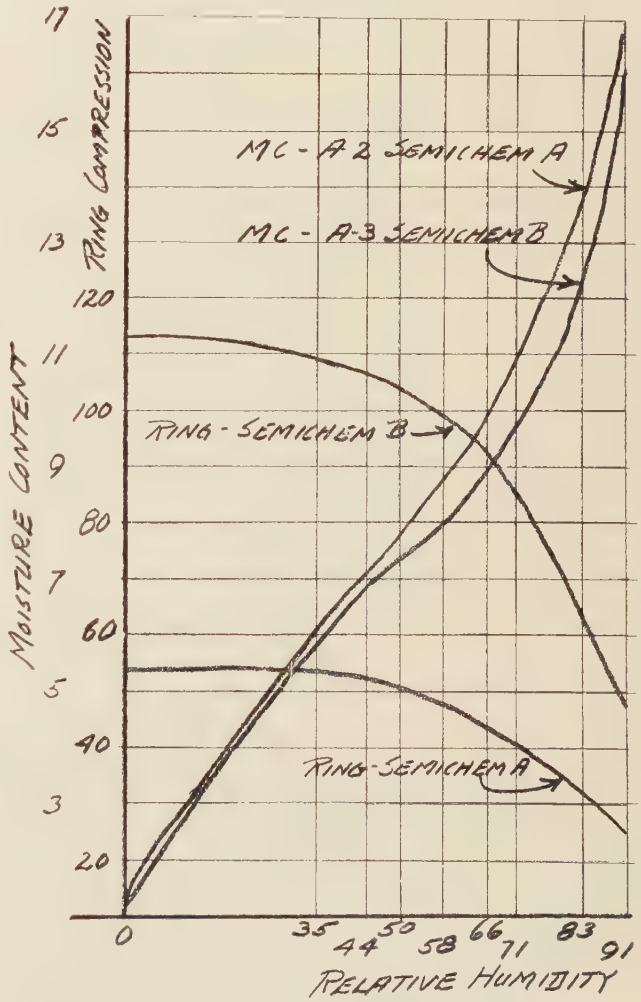


Fig. H-2. Ring compression and moisture content versus relative humidity of three semichemical corrugating mediums

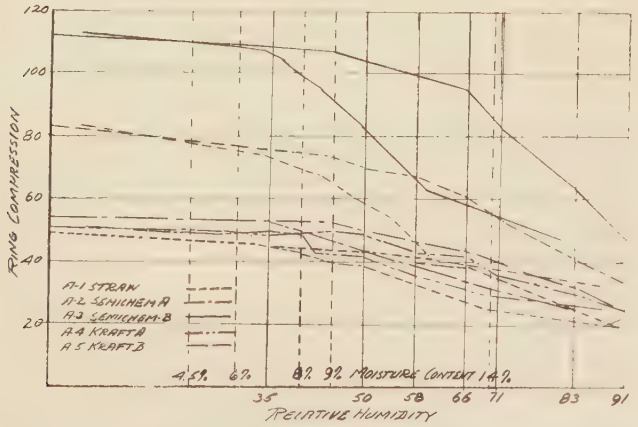


Fig. H-3. Relative humidity-moisture content relation effect upon ring compression test results

Fig. H-5

our percentage values. Again, here, the results follow rather closely those predicted by Seborg, Doughty, and Baird, particularly within the so-called corrugating range. A greater separation, again the space between the lines widens as the moisture content increases.

Just prior to our deadline, while examining Fig. G-6, we were surprised to see that line A-2 took quite a drop at the 9% position. Investigation showed that we had erred in our calculation. The point should have been 88.5 instead of 81.5. The maximum variation then, for all seven stocks, should have been from 83.2 to 88.5 or 5.3 points instead of the 6.5 points shown on Fig. G-6.

All the test values shown in Fig. G-5 were averaged at each of the selected moisture content points shown in G-5. These averages are shown in Fig. G-7. Like averages of Fig. G-6 are also pictured on G-7. Figure G-7 then pictures a comparison of the composite averages of G-5 and G-6.

Figure G-8 pictures Fig. E-10 on a relative rather than on an actual basis. In this instance it is surprising how the lines on the decline are almost one, yet in the lower ranges there is more of a spread. This at first glance appears to be contrary to the Seborg, Doughty, and Baird theory. However, this test measures an entirely different property than the other tests reviewed. Additional study seems called for before voicing an opinion.

Figure G-9 pictures the consolidated relative test results of four different procedures showing the test results versus the moisture content relationship. For the sake of greater clarity all tests made on any one instrument or type of instrument were combined proportionately in the line that correctly identifies that test (all lines are clearly identified). Therefore, this graph, with only four lines, pictures 11 different *series* of tests made on a wide variety of papers and upon four different types of testing equipment. The tests were conducted in different plants by different people upon different papers and with slightly modified techniques. We had thought that the different testing instruments might show great variation between plotted points. Yet, an examination of G-9 shows that, with the exception of the pin adhesion test which pictures an entirely different property than those shown on the other lines, you will again note the position of the lines is not too greatly disproportionate.

The relative test values form more similar curves than do the actual test values and the spread between the "relative" curves is much less than the spread between the "actual" curves, we still have been unable to find a means of showing values for more than one test series report on any one curve. Various other comparisons were then tried (some of which are pictured on Figs. G-X, G-Y, and G-Z) without success.

While we have been unable to substantiate the findings of Seborg, Doughty, and Baird, we have made some progress. It may be that continued investigation would identify the proper method or methods for correlating these results so that knowing a given moisture, a given test result at that moisture, that these two figures could then be plotted against a previously established curve and any other desired point would be known in terms of its relationship to the measurement just made.

Such would enable a papermaker, or a corrugating machine operator, or a quality control girl, or management, etc., to tell how this moment's production will be after test samples would be submitted to today's standard TAPPI test procedure. We would know now, instead of tomorrow, how good or how bad was the quality of our work. We would know now, instead of a few hours from now, or instead of tomorrow, how the quality of this minute's production will compare with the last time this particular order was run several months ago.

Until the present, there has been no possible method within the entire paper industry, with which we are familiar, that would provide this type of information. All that we have been able to do is to find our answer when it is no longer news.

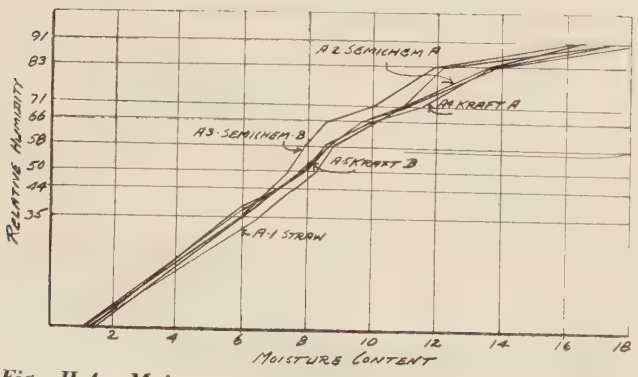


Fig. H-4. Moisture content versus relative humidity

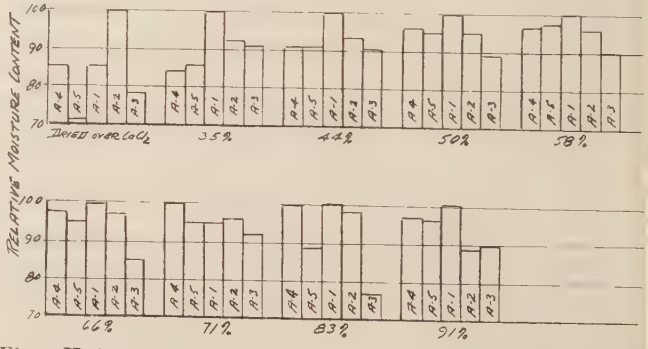


Fig. H-6. Relative moisture content versus relative humidity. Per cent of maximum variation in moisture content of five corrugated mediums at specified relative humidities

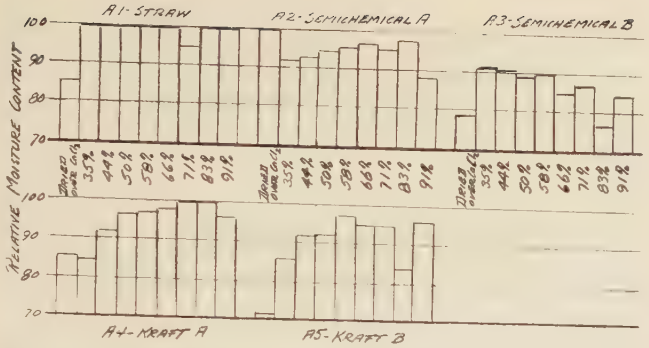


Fig. H-7. Relative moisture content versus relative humidity. Per cent maximum variation of moisture content at specified relative humidities by five corrugating mediums

but has become history, according to B. E. Sooy of Wolverine Carton Co.

Would it be important for you, or for your people to be able to determine this information? Could such information be readily put to good use? Would it be helpful to you or to your operating personnel to be able to know within reasonable precision just how their work was going to stack up against previous run orders and against standard samples? It may be that we are on the trail of the tool for which the industry has been seeking for many years. It may mean that in this work, done 20 years ago, there has been lying dormant, much of the information which a large portion of the paper manufacturing and converting industry has needed.

If the answer should be found within a modification of the suggested procedures, then how could such information be put to use? One method that we envisage is to include with the instructions that now accompany each new order to mill or plant, a special curve for each test that is important to that order. The machine operator would make a quick moisture check followed immediately by the particular test in which he was at that time interested. Then, by laying these two points on the curve, possibly also making a slight correction, the operator would have a sorely needed tool—a means of making a direct comparison between this moment's production and any previously established standard.

Another means for using such information might be through the modification of the circular slide rule. Such things are now in use in a number of mills and plants where they are being used to great advantage by operating personnel. They could readily be used here provided the basic thesis was correct.

Until a means is provided for quickly comparing the quality of present production with established standards or past performance, is the use of automatic production controls feasible? We do not profess to know the answers.

We have been advised that, should this 20-year-old theory prove out, that it could become one of the most helpful and significant developments of many years. So, what if it does not prove out for all tests, maybe just a few tests, maybe only for one test. It will still provide helpful information, which is not otherwise obtainable, and will do so quickly enough for corrections to be made promptly if they are needed.

In the language of the dictionary, we find—

"test—1. That by which the presence, quality or genuineness of anything is determined; a means of trial . . . . 3. A particular process or method for doing this. . . ."

"trial—2 . . . putting to the proof . . . . 5. Tentative or experimental action in order to ascertain results; an experiment . . . ."

"proof—1. Evidence sufficient to establish a thing as true . . . . 4 . . . demonstration. . . ."

"demonstration—1. The proving of anything conclusively, as by arguments, reasoning, evidence, etc. . . ."

"truth—. . . 2. Conformity with fact or reality . . . ."

"quality— . . . 3. Character with respect to excellence, fineness, etc., or grade of excellence. . . ."

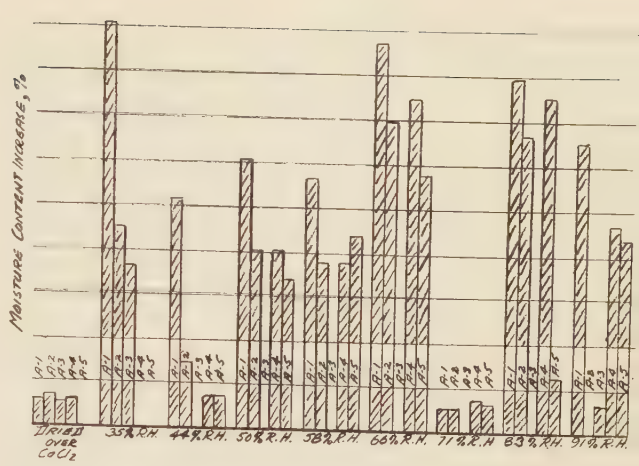


Fig. H-8. Percentage of increase in moisture content over the minimum moisture content variation of five corrugating mediums at nine specified relative humidities

Transposing the language of the dictionary into language of more common usage, then,

Tests are a means whereby, through trial, proof of true quality is demonstrated.

A test supplies a method for measuring a quality of a product. As such, tests are not necessarily important of themselves. Their value depends upon their maintaining a constant relationship with, and accurately picturing that quality of the material being evaluated, for which the tests are indicators. In other words, we are not interested in a burst, flat crush, ring compression, or any test, as such. We are concerned with any test only as the test result serves as an indicator of the performance to be reasonably expected from a corrugated box or other product which we wish to evaluate.

Curves that depict the results of tests made upon papers and boards that contain inorganic additions (either internally or externally applied) are quite different from curves that depict the results of tests made upon papers and boards that are similar but that do not contain inorganic additives.

The ratio of actual performance versus indicated performance (test results) of products made from inorganic-containing materials is likewise quite different from the ratio of actual performance versus indicated performance of like products made from materials that are similar but that contain no inorganics.

A means for improving the correlation of test results and performance of the different boards and papers and *between* the different boards and papers seems to be in order. For example, conceivably, two sheets could be made from the

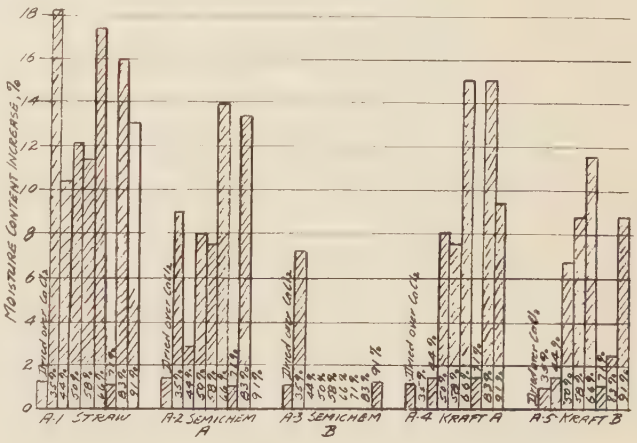


Fig. H-9. Percentage of increase in moisture content over the minimum moisture content variation at nine specified relative humidities of five corrugating mediums

same furnish and be identical, for all practical purposes, in every respect except that one was lighter in weight and caliper than the other. On a moisture-free basis one of these sheets (no 1) weighed 25 lb. and the other, the lighter sheet (no. 2), weighed 20 lb., each per 1000 sq. ft. Each contained 5% moisture by weight. Sheet 1 was composed of 25 lb. of fiber and $1^1/_4$ lb. of moisture. Sheet 2 was composed of 20 lb. of fiber and 1 lb. of moisture. Clay, equal to 20% of the moisture-free sheet weight, was added to either the furnish or the surface of a portion of sheet no. 2, making sheet no. 3. Sheet 3 would then be composed of multiples of 20 lb. of fiber, 5 lb. of clay, and 1 lb. of moisture.

A The moisture-free weight sheet 1 and sheet 3 were the same, 25 lb. each. Sheet 1 contained 20% more moisture ($1^1/_4$ lb.) than did sheet 3 (1 lb.).

The moisture content of sheet 1 was 5% and the moisture content of sheet 3 was 4%; yet the ratio of moisture content to moisture-content fiber was the same in both sheets, 5%.

Sheet 1 also contained 20% more moisture-free fiber than did sheet 3; yet both sheets weigh the same, 25 lb. per 1000 sq. ft.

B. Sheets 2 and 3 each contained the same weight of moisture; yet the moisture content of sheet 2 was 5%, 20% more than the moisture content of sheet 3 (4%).

Sheets 2 and 3 each contained the same ratio of moisture to moisture-free fiber (5%); yet the moisture content of sheet 2 was 20% more than in sheet 3.

Sheets 2 and 3 each contained the same amount of fiber (on a moisture-free basis); yet sheet 3 weighed 25 lb.—20% more than sheet 2 (20 lb.)

C. Sheet 1 contained 20% more fiber and 20% more moisture than sheet 2; yet both had the same moisture content percentage (5%).

These three sheets probably differed greatly in performance. The strength characteristics of sheets 1 and 2 were probably superior to the strength characteristics of sheet 3. The opacity and printing characteristics of sheet 3 were probably superior to the opacity and printing characteristics of sheets 2 and 3.

What type of measurement will most clearly picture the true relative conditions of sheets 1, 2, and 3?

Tests of all properties of paper products are based upon the test specimens being brought to equilibrium with a 50% R.H. and temperature of 23°C. The moisture content is based upon the ratio of moisture to the weight of the sheet. As no differentiation is made between the moisture to fiber ratio and the moisture to total weight ratio, this method will not picture the true comparison between sheets 1, 2, and 3 in our hypothetical example. Does the addition of inorganic material to a sheet affect the relationship between the fibers and the moisture content? Is the effect of the moisture content upon the inorganic portion of a sheet similar to its effect upon the fibers? Or does the moisture content act only upon the fibers and not upon the inorganics that are present? Or does it act upon both in like manner?

Would it be helpful to be able to differentiate between the fiber versus moisture, inorganics versus moisture, and the total moisture-free weight versus moisture relationships?

Would a reading showing the relationship of moisture to fiber, present a truer picture of the performance to be expected than will the ratio of moisture to the total weight of the sheet? What is it that we are trying to find out when we make a moisture measurement? Of course we want to know the moisture content, but isn't that the means to the end rather than the end itself? Aren't we interested in moisture content because experience has shown that with variations in moisture content becomes variation in the performance of the sheet being evaluated? Is this variation in performance due to the effect of the moisture upon the fibers or upon all the ingredients in the sheet?

Sheets made from the same furnish should have the same moisture content at any given relative humidity. However, as the *inorganic* content of the furnish changes, so does the moisture content at that relative humidity, but only in terms of the oven or in gravimetric language. It appears, based upon many thousands of evaluations, that in such instances the moisture content of the fibers present in both sheets is the same. As the hygroscopicity of the inorganic material and the fibers vary, the moisture content (in the terms of the oven) will vary likewise. It is likewise true that fibers of different origin may contain different moisture content at any relative humidity, however, the moisture content difference between fibers, is minute compared to the moisture content difference between fibers and inorganics, such as diatomaceous earths, clays and inorganic fibers and fillers. This phenomenon is particularly important when evaluating moisture content in clay-coated and filled papers and boards.

Hitherto, limited by the gravimetric method, we have been able to consider moisture content only in terms of the total weight of the sheet. We have not been able readily to determine the ratio of moisture content to fiber. There are now a number of instruments that would make such readings not only possible, but easy to make.

The electrical resistance of kraft and other grades used in the corrugated industry such as straw, bogus, jute, semi-chemical, and similar sheets, at the percentages which are vital in production, namely, 4, 5, 6, 7, 8, and 9, is as follows in terms of certain electrical instruments:

Moisture content, %	*Electrical resistance, megohms*
4	16,000
5	4,000
6	800
7	123
8	23
9	8

This illustrates the relative enormous electrical change which takes place with each small shift in moisture percentage.

These figures are necessarily based on always contacting the paper in the same way electrically and the values shown result from continued application of certain similar instruments in a standard manner.

We are no longer limited exclusively to the gravimetric method. We are free to use the method or methods whereby proof of true quality is best demonstrated. Probably, when evaluating clay-filled, clay-coated, and other inorganic-containing papers and boards, the proof of true quality will be best demonstrated if the inorganic material both will and will not enter into the equations.

A correlation of tests based upon these two sets of figures no doubt supply the best indication (now available) of the performance to be expected from the materials evaluated.

Figures A-2 and A-3 picture two different sheets of semi-chemical corrugating medium. In the low moisture range one of these sheets tested much higher than the other. In the higher moisture range the two curves are much closer together. Could this be due to the effect of inorganic material in one of the two sheets? Would a truer picture of corrugated box performance be shown if relative humidity were used as the basis for evaluating board characteristics? Would we know more if we measured the relationship of moisture content to fiber? Would our purpose be better served by measuring moisture content as at present? Or is there no advantage of one method over the other?

If the answer to either of the last two questions is "yes," then another question is raised. How precise must test results be in order for them to be meaningful?

Test A reports on results of the ring compression test on five different corrugating mediums. Reference to the report will show that test A was performed according to approved TAPPI Standards. Reference to Table A will show that at each relative humidity used there was variation in the moisture content of the five sheets tested.

Figure H-1 combines curves A-2 and A-3. These curves picture the test result–moisture content relation. On H-1 is

also pictured the same test results versus relative humidity. It will be noted that there is considerable difference between the two sets of curves, although they picture what is supposed to be an identical condition.

Figure H-2 pictures the test value versus relative humidity and the moisture content versus relative humidity for these same two papers.

The greatest actual difference between points in no instance exceeds 2.1. How does this difference appear percentage-wise? Figure H-5 pictures the percentage of maximum variation occurring between the five corrugating mediums at the selected relative humidities. You will notice that in three instances the percentage of variation exceeds 20% and that in 14 instances out of 45 the percentage of variation exceeds 10%. Thus in 31% of the comparisons made the error exceeded 10% in magnitude.

In actual "points" the degree of variation at given relative humidities may not appear too great. In *percentage of difference* this variation seems excessive.

Figure H-6 pictures the relative moisture content that exists between the five sheets tested, with the relative miosture content figured for each of the selected relative humidities. They are grouped according to relative humidity.

Figure H-7 presents the same information except that in Fig. H-7 the grouping is by product rather than by relative humidity.

Figure H-7 clearly shows that, in approximately 77% of the tests made, A-1 (straw) had the highest moisture content of the five sheets evaluated. Wondering if this were due to some special condition, we reversed the computation showing the increase in moisture content percentage over the minimum moisture content present at each relative humidity. Again the results are pictured grouped by relative humidity (H-8) and by product (H-9). And again the variation that exists between the different sheets evaluated appears excessive at each relative humidity. Apparently we are dealing with a general rather than an isolated condition.

It is our understanding that for test results to be precise, to have meaning, there must be some common point to serve as a basis for the desired comparison. Otherwise we are again adding fractions with unlike denominators. If a test result is based upon a known error of 25%, then how correct can the finished work be? If a test result is based upon a known error of 10%, then what degree of error is to be expected in the test result? Under such conditions can one have confidence in the test result? How great must an error be until it becomes an error of consequence?

Figure H-3 pictures all five papers reported upon the test A. On this one chart, all five papers are shown both in the test value versus moisture content relation and in the test value versus relative humidity relation. You will readily note the variation between corresponding curves.

How much variation actually exists between the moisture content measurement and the relative humidity measurements? That relationship is graphically shown by Fig. H-4. There, all five sheets from test A are shown in the moisture content versus relative humidity relationship. Figure H-4 definitely is not a set of five straight, parallel lines.

TAPPI Standard T 402 m-49 specifies that all papers reach equilibrium with an atmosphere of 50% R.H. and a temperature of 23°C. It is our understanding that these conditions are specified because they are intended to provide a basis for making equitable evaluations or comparisons between papers and between papers and established standards. However, all paper products do not reach a common content percentage at 50% R.H. or at any other relative humidity. Both test results and performance of paper products will change as the moisture content percentage varies. Therefore, are we using a yardstick that will not always be 36 in. long? If so, will the

Table T-1. Moisture Content and Relative Moisture Content versus Test Values and Relative Test Values at Specified Relative Humidities

Data from Table A-1

A H & D ring test, all samples 1/2 by 6 in. M.D.	*Dried over CaCl*	*35% R.H.*	*44% R.H.*	*50% R.H.*	*58% R.H.*	*66% R.H.*	*71% R.H.*	*83% R.H.*	*91% R.H.*
No. 1 Straw—30 lb.									
Test value									
Actual	49.0	46.0	44.0	43.0	40.0	39.0	36.0	25.0	19.0
Maximum, %	100.0	93.9	89.8	87.8	81.6	79.5	73.5	51.0	38.8
Moisture content									
Actual	1.2	6.5	7.5	8.3	8.8	10.1	10.9	13.8	18.1
Maximum, %	6.6	35.9	41.4	45.9	48.6	55.8	60.2	76.2	100.0
No. 2 Semichemical A—28 lb.									
Test value									
Actual	54.0	53	53	50	47	44	40	32	25
Maximum, %	100.0	98.1	98.1	92.5	87.0	81.5	74.1	59.2	46.3
Moisture content									
Actual	1.4	6.9	7.0	7.9	8.5	9.8	11.0	13.5	16.6
Maximum, %	8.4	36.1	42.2	47.6	51.2	59.0	66.3	80.7	100.0
No. 3 Semichemical B—36 lb.									
Test value									
Actual	112	109	107	104	100	95	83	64	47
Maximum, %	100.0	97.3	95.5	92.8	89.2	84.8	74.1	57.1	42.0
Moisture content									
Actual	1.1	5.9	6.8	7.4	7.9	8.6	10.1	11.9	16.2
Maximum, %	6.8	36.4	42.0	45.7	48.8	53.1	61.7	73.5	100.0
No. 4 Kraft A—26 lb.									
Test value									
Actual	51	49	50	49	43	42	36	30	25
Maximum, %	100.0	96.1	98.0	96.1	84.3	82.4	70.6	58.8	49.0
Moisture content									
Actual	1.2	5.5	6.9	8.0	8.5	9.9	11.5	13.7	17.5
Maximum, %	6.9	31.4	39.4	45.7	48.6	56.6	65.7	78.3	100.0
No. 5 Kraft B—33 lb.									
Test value									
Actual	83	76	74	70	68	61	54	41	33
Maximum, %	100.0	91.6	89.2	84.3	81.8	73.5	65.1	43.4	39.8
Moisture content									
Actual	1.0	5.6	6.9	7.9	8.6	9.6	10.9	12.2	17.4
Maximum, %	5.7	32.1	39.7	45.4	49.4	55.2	62.6	70.1	100.0

changes in length of the yardstick be in terms of inches or of minute fractions of an inch?

It is well known and established as a fact that fibers of different origins will vary in moisture content at any given relative humidity. Wool, cotton, flax, hemp, sisal, etc., will vary in moisture content at any given relative humidity. Papers made from them will likewise vary in moisture content at any given relative humidity. Therefore, since—

Test values in paper products will vary as the moisture content percentage changes, and . . .

Since the moisture content percentage of paper product will vary at any given relative humidity according to the source of origin of the fibers composing the paper, then . . .

Relative humidity does not supply a uniform base upon which comparisons of paper characteristics and comparisons of test results can be made with either accuracy or precision . . . if the papers contain fibers from different types of plants.

Not only is the foregoing an accepted fact, it is often the basis for using certain types of fibers in order to obtain desired results. For example, some flour sacks are still made from papers actually containing old hawsers and other rope. At any relative humidity, bags made from these papers do not become as dry as bags made from the (now) more popular papers, and do not develop leaks as readily as cross scores.

In test A, one sheet of straw, two semichemical sheets, and two jute sheets were used. Figures H-6, H-7, H-8, and H-9 show that considerable variation in moisture content at any relative humidity exists between the two semichemical sheets and likewise between the two jute sheets. The experiment was not sufficiently comprehensive, was not intended to determine whether this variation is due entirely to the difference in sheet weight (in both instances a light and a heavier sheet were used) or if this variation in moisture content at given relative humidity between sheets of like nature is also general.

Figure T-3 pictures more clearly the moisture content variation between the two semichemical sheets and between the two jute sheets at like relative humidities. It also pictures a comparison of the relative strength results of these papers at the different relative humidities.

Fortunately, the greatest degree of variation occurs at the extremities of the moisture content and relative humidity scales—the central portions, which run more uniform than the extremities, are generally most important. But this situation will be of but slight assistance when using or testing paper products in the higher or lower portions of the moisture content and relative humidity scales.

Will results be more precisely gaged if relative humidity or moisture content percentage is the common basis for testing purposes? Or are there some other, some more stable characteristics that would serve even more satisfactorily? Is there now available some new product, method, procedure, etc., that can serve as the basis for making more equitable comparisons than is possible by the established approved method which was probably the best available when it was adopted?

We do not know what degree of accuracy or of precision is either needed or expected. Nor do we know if necessary degrees of accuracy and precision can possibly be attained with a potential error in the basic premise upon which the accuracy and precision of tests is based. If the necessary degree of accuracy and precision can be attained under some circumstances, is there any reasonable assurance that the necessary degree of accuracy and precision can be maintained from test to test?

Science is based upon "truth" and the continued search for new truths. How "true" must be our basic premise for reasonably correct test measurements? And does the "degree of truth" vary when results, based upon "truth," are to be used as production controls, laboratory investigations, or referee purposes?

And incidentally, how many referee decisions would be needed if product variation never exceeded 0.25%?

All test procedures are based, to at least some extent, upon the moisture content present when the other tests are made. Would the purposes of the corrugated box industry be better served if, instead of present methods, another procedure became the standard for making moisture measurements?

In conclusion, we find that the occurrence of slight variations in moisture content percentage in the sheets evaluated was responsible for major changes in the value of the tests investigated.

Changes of importance occurred throughout the "normal corrugating moisture range" ($4^1/_2$ to 9% moisture content).

Still greater changes in test values occurred within the range of moisture content likely to be encountered when boxes are in equilibrium with the higher relative humidities which can

Table T-2. Moisture Content Variation at Specified Relative Humidities

Basic data from Table A-1; A—H & D ring compression	*Dried over CaCl*	*35% R.H.*	*44% R.H.*	*50% R.H.*	*58% R.H.*	*66% R.H.*	*71% R.H.*	*83% R.H.*	*91% R.H.*
No. 1 Straw—30 lb.									
Moisture content	1.2	6.5	7.5	8.3	8.8	10.1	10.9	13.8	18.1
Difference from maximum M.C.	0.2	..	..	..	..	..	0.6	..	..
Maximum M.C., %	85.4	..	..	..	..	..	94.8	..	..
Increase over minimum M.C.	0.2	1.0	0.7	0.9	0.9	1.5	0.9	1.9	2.1
Per cent of increase	1.2	18.2	10.4	12.2	11.4	17.4	1.1	16.0	13.1
No. 2 Semichemical A—28 lb.									
Moisture content	1.4	6.0	7.0	7.9	8.5	9.8	11.0	13.5	16.0
Difference from maximum M.C.	..	0.5	0.5	0.4	0.3	0.3	0.5	0.3	2.1
Maximum M.C., %	..	92.3	93.4	95.2	96.0	97.0	95.7	97.8	88.4
Increase over minimum M.C.	0.4	0.5	0.2	0.5	0.6	1.2	1.0	1.6	..
Per cent of increase	1.4	9.1	2.9	8.1	7.6	14.0	1.1	13.4	..
No. 3 Semichemical B—36 lb.									
Moisture content	1.1	5.9	6.8	7.4	7.9	8.6	10.0	11.9	16.2
Difference from maximum M.C.	0.3	0.6	0.7	0.9	0.6	1.5	1.5	1.9	1.9
Maximum M.C., %	78.5	90.8	90.7	89.2	89.8	85.1	87.0	76.4	89.6
Increase over minimum M.C.	0.1	0.4	..	..	..	..	..	..	0.2
Per cent of increase	1.1	7.3	..	..	..	..	..	..	1.3
No. 4 Kraft A—26 lb.									
Moisture content	1.2	5.5	6.9	8.0	8.5	9.9	11.5	13.7	17.5
Difference from maximum M.C.	0.2	0.1	0.6	0.3	0.3	0.2	..	0.1	0.6
Maximum M.C., %	85.4	84.6	92.0	96.3	96.6	98.0	..	99.3	96.7
Increase over minimum M.C.	0.2	..	0.1	0.6	0.6	1.3	1.5	1.8	1.5
Per cent of increase	1.2	..	1.5	8.1	7.6	15.1	1.5	15.1	9.4
No. 5 Kraft B—33 lb.									
Moisture content	1.0	5.6	6.9	7.9	8.6	9.6	10.9	12.2	17.4
Difference from maximum M.C.	0.4	0.9	0.6	0.4	0.2	0.5	0.6	1.6	0.7
Maximum M.C., %	71.4	84.6	92.0	95.2	97.7	95.1	94.8	88.4	96.1
Increase over minimum M.C.	..	0.1	0.1	0.5	0.7	1.0	0.9	0.3	1.4
Per cent of increase	..	1.0	1.5	6.8	8.8	11.6	1.1	2.5	8.8

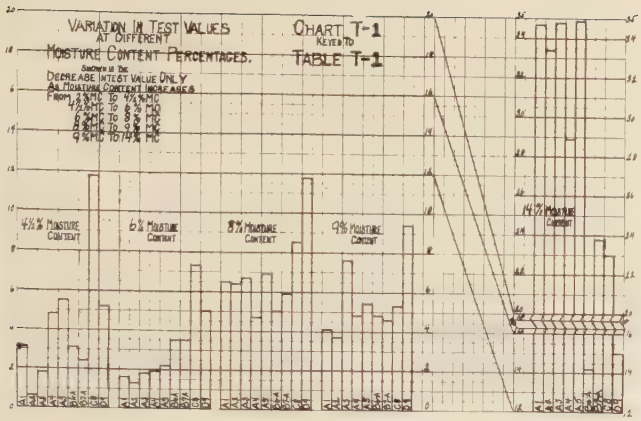

VARIATION IN TEST VALUES AT DIFFERENT MOISTURE CONTENT PERCENTAGES.
CHART T-1 KEYED TO TABLE T-1
4½% MOISTURE CONTENT
6% MOISTURE CONTENT
8% MOISTURE CONTENT
9% MOISTURE CONTENT
14% MOISTURE CONTENT

Fig. T-1

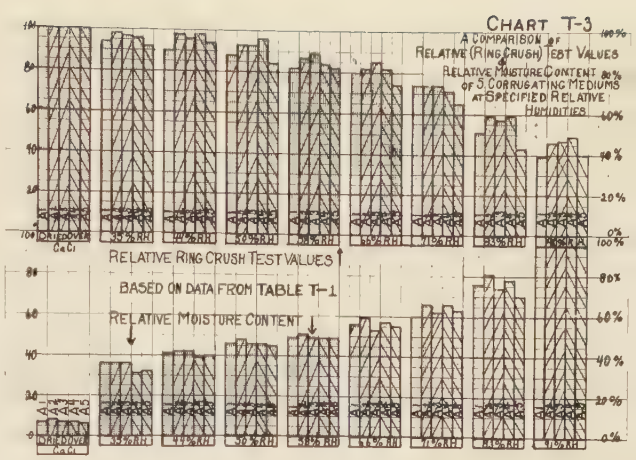


CHART T-3
A COMPARISON OF RELATIVE (RING CRUSH) TEST VALUES & RELATIVE MOISTURE CONTENT % OF 5 CORRUGATING MEDIUMS AT SPECIFIED RELATIVE HUMIDITIES
RELATIVE RING CRUSH TEST VALUES
BASED ON DATA FROM TABLE T-1
RELATIVE MOISTURE CONTENT

Fig. T-3

reasonably be expected in the course of normal shipping, storage, and handling of corrugated boxes. Changes in the values from flat crush and single flute tests were more uniformly distributed throughout this $4^1/_2$ to 14% moisture content than were the results of ring crush tests. Changes in flat crush and single-fluter test values were more pronounced throughout the corrugating range ($4^1/_2$ to 9% moisture content) and less throughout the storage range (9 to 14% moisture content) than were ring crush test values.

The decrease in test value as the moisture content percentage increases signifies that, in order to be strong enough in the presence of higher relative humidities, corrugated boxes will have to be much stronger than would be needed were they only subjected to the lower relative humidities.

Incidental to the planned investigations there developed the following:

1. Re-evaluation of some tests in current use may show that some of these tests do not portray with precision the information expected.
2. An over-all pattern for sampling procedure might improve the accuracy of test results over test results obtained from the sampling methods in general use.
3. Is the pin adhesion test a true measure of the bonding strength of the corrugating adhesive or do paper characteristics influence the pin adhesive test results?
4. Re-evaluating tests originally designed for laboratory usage might develop tests better suited to serve as production controls.
5. It is highly desirable to have some means for promptly, simply, and accurately measuring the quality of current production. Attempts to duplicate the work of Seborg, Doughty, and Baird along this line, using data from Part I, were not successful. Additional investigation may supply this information.
6. The gravimetric method of making moisture determinations does not differentiate between the fiber versus moisture content ratio and the moisture-free versus moisture content ratio. Thus an accurate base is not supplied for comparing ordinary papers with clay-filled or coated papers. Proved developments indicate that other than the gravimetric method may supply a more complete picture of the moisture content fiber versus moisture content–moisture-free ratios.
7. Papers containing fibers of different types probably will not contain equal moisture content percentages at like relative humidities. Papers containing fibers of the same type may not contain equal moisture content percentages at like relative humidities. The test values of most paper products will vary as their moisture content percentage varies although not necessarily in proportion to the moisture change. Therefore a basis for comparison of test results, that is more uniform than the currently used relative humidity, may supply a truer picture of comparative values of paper tests.

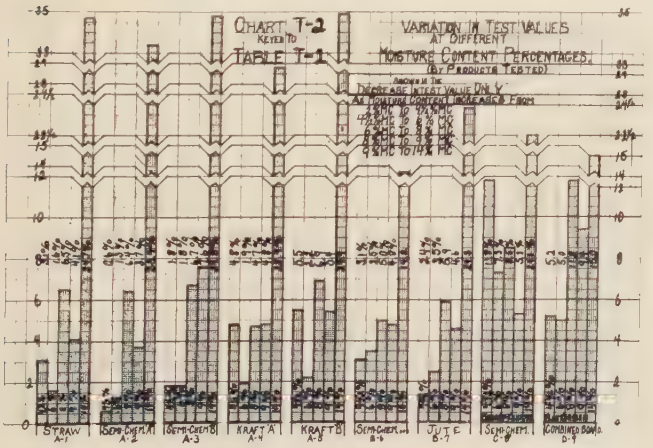


Fig. T-2

We believe that any of the foregoing could be well worth further investigation. We will be pleased to cooperate with those who are sufficiently interested to invest the time and effort needed for such purposes. If desired, we will set up round-robin procedures and serve as a central point or clearing house for the collection, correlation, and distribution of the results of the round-robin and/or other methods of evaluation.

We greatly appreciate the privilege of appearing before this forum and thank you for your indulgence. We also wish to thank Mr. Fuko for his invitation to participate in this meeting and particularly to thank the seven men and their companies for making the tests and accumulating the data upon which this paper is based. Working with these men has been fun and instructive. We hope that the information presented will prove helpful to others.

Q.: What do you consider a reasonable range of viscosity when this characteristic is under good control?

Mr. Carlisle: Plus or minus 2 sec.

Q.: How is the test information handled?

Mr. Candell: Tests come in according to schedule. New lots and samples are prepared and tested. Results were summarized periodically. Unusual results were reported direct to the purchasing department.

Q.: What do you do with a vendor whose tests fall below minimum or above maximum?

Mr. Candell: We work with the vendor through the purchasing department to get him to improve his product to our standards. Failure to meet the standards can result in refusal of merchandise or calcellation of contract; where a vendor's tests run high, his specifications are reviewed and modified to keep the product within range.

Q.: What is a "good" cost per 1000 sq. ft., for adhesive?

Mr. Carlisle: The best cost you can run. Good coverage: $2^1/_4$ lb.; average $2^1/_2$ lb. Due to the nature of the machine, varying amounts of adhesive will be used.

Q.: In what units are your flat compressions reported in the first part of your paper, and on what type of machine were the flat compressions made?

Mr. Schoenberg: Flat crush was reported as pounds per 10 sq. in.

Q.: You referred to receptivity of medium to adhesive. Did I understand you correctly that the greater the absorbancy of the medium, the higher the viscosity of the adhesive which should be used and the less amount of adhesive will be used?

Mr. Carlisle: This is difficult to answer. Receptivity would be low. A high viscosity starch would be recommended for a highly absorbent medium.

Salt Cake Feeding in Chemical Recovery Unit

H. A. STOESS, JR.

In the chemical recovery unit which serves the kraft pulp mill, spent chemical is recovered through the burning out of the organic matter that is present in the black liquor that results from the digesting process. From the digesting process, evaporators perform the function of concentrating the black liquor. From the last, or disk evaporator, the heavy black liquor, which has a temparature of 180 to 230° F., a pH of 9.5 to 13.0, 50 to 60% solids, and a specific gravity of 1.2 to 1.35 Baumé, flows to the salt cake mixing tank by way of a flow box. In the salt cake mixing tank, the make-up chemical, sodium sulphate, more commonly called salt cake, is added to the liquor. This make-up chemical is required to replace the sodium salts and sulphur lost in the pulp mill processes. The salt cake mixing system includes equipment for uniform feeding of the screened make-up chemical, which is evenly mixed with the heavy black liquor in the salt cake mixing tank. This black liquor and salt cake has a temperature of from 180 to 230° F., pH of 10 to 13.5, 50 to 70% solids, and a specific gravity of 1.2 to 1.35 Baumé. This liquor is then heated through heat exchangers and delivered to the burning nozzles in the recovery furnace.

Heretofore, the make-up salt cake has been stored in vertical or flat storage bins, and from these storage bins the salt cake is conveyed to a service bin above the mixing tank. From the service bin, the salt cake is discharged through a calibrated, variable speed screw feeder to the mixing tank. The control of this screw feeder is manual. Since salt cake is hygroscopic, a vibrating screen is more or less a necessity in the top of the mixing tank to reject particle sizes greater than $^1/_8$ in. that occur in the service bin as shown in Fig. 1.

Considerable maintenance and operating difficulties have been experienced with the screw feeder and the vibrating screen. The failure of the screw feeder is not just occasional, but an almost accepted inevitability. Nearly every time the plant experiences an unscheduled shutdown, the salt cake mixing tank has to be steamed out. The steam during this operation enters the service bin through the vibrating screen and the screw feeder, causing the salt cake remaining in the service bin as well as the screen and feeder to solidify into rock, and, in the following restart, trouble develops.

Methods of accomplishing this same operation to eliminate these difficulties have been discussed, and, the most logical solution is the conveying of the make-up salt cake direct from the main storage bin to the mixing tank through pneumatic means. This method eliminates entirely the service bin, screw feeder, and vibrating screen. A complete flow diagram of this method is shown in Fig. 2. Vertical storage bins only would be used in this method.

Starting at the main storage bin, a vibrating feeder is used to discharge the salt cake to a swing hammer pulverizer through a spout having a magnetic separator to protect the pulverizer against tramp iron and kindred materials. The pulverizer breaks the lumps of salt cake to make a minus $^1/_8$-in. product. After passing through the pulverizer, the salt cake is then delivered to the conveying line through a rotary feeder or airlock. The conveying line, made up of schedule 40 steel pipe, is activated by a positive pressure blower which will blow the salt cake to a single-stage cyclone receiver above the mixing tank in the recovery building. This single-stage cyclone is mounted above the salt cake mixing tank. From this cyclone the salt cake will be discharged direct to the mixing tank through a truncated spout. This spout would mount on the portion of the mix tank where the vibrating screen was installed, and would be equipped with a porthole for visual observation.

H. A Stoess, Jr., Sales Engineer, Fuller Co. Catasauqua, Pa.

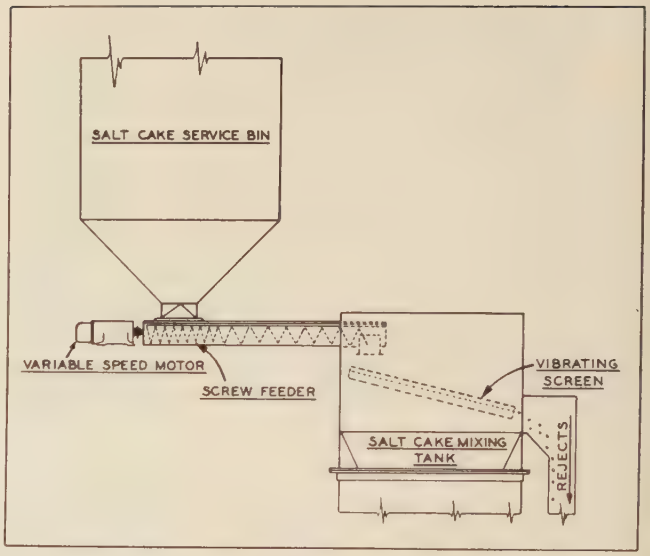


Fig. 1

Since air from the conveying line would be delivered to this cyclone under pressure, a vent line to the precipitator is used to dissipate this air. In order to be certain that flash steam and vapors from the mixing tank do not enter the cyclone receiver, a butterfly is installed in the vent line to the precipitator to regulate the amount of air going to the precipitator and for making a slight down draft through the outlet of the cyclone receiver, truncated spout, and screen compartment. From the mixing tank, a vent stack is usually installed for the venting of the flash steam and vapors. A butterfly is also installed in this vent stack to regulate the amount of draft to the mixing tank. Since a slight down draft and additional air would be brought into the salt cake mixing tank from the cyclone receiver, it is suggested that this vent line from the salt cake mixing tank be run to the precipitator.

In the event of an unscheduled shutdown, the steaming out of the mixing tank can be done without harm to the other component parts. The truncated spout between the cyclone receiver and the mixing tank would be removed and the intake to the mixing tank capped with a blank flange. Complete isolation of the cyclone from the mixing tank is a reality.

Control of this system for the proper feeding of salt cake to the mixing tank can be accomplished through a variable rheostat on the vibrating feeder below the salt cake storage bin. This would regulate the flow of salt cake from the storage bin through the pulverizer and on to the mixing tank. The amount of feed could be determined in the same manner that is now being used, but, there is the possibility that instrumen-

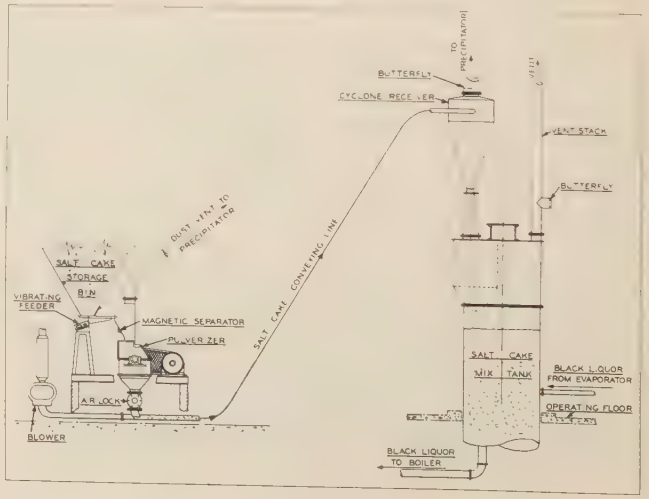


Fig. 2

tation may be used in operating all of this equipment automatically. This could probably be accomplished through liquid specific gravity or density instruments.

Some mills keep a continuous inventory on the amount of salt cake used per day and month by actual weight through the use of scales. While it would be extremely difficult to maintain this type of inventory control on this system, an electronics level control in the storage bin could be used. This electronic level control would indicate the amount of depth of the material within the storage bin, and, from this, the amount used could be very closely estimated.

This method of delivering salt cake to the mixing tank in the recovery building is believed to offer a much simpler method than is now used, and is one that would eliminate considerable maintenance.

Received March 18, 1953.

A Mill Control Method for Wet-Strength Papers

A. G. DURGIN and W. G. BAKER

Although there are standard methods for measuring wet strength of a sheet of paper, the time involved in manipulation is too long to be of value in control of machine operation, even in cases when full wet strength in the finished product is developed at the reel. In our operation we produce paper with different degrees of wet strength, each of which is designated by a colored stripe indicative of the wet strength in a sheet within a relatively narrow band, and with a considerable degree of uniformity throughout a machine run. There was need for a test which could be performed by the machine testers, that would correlate closely with test data obtained on conditioned sheets, and which would be quick enough to detect variations in quality and allow corrections to be made on the machine as soon as possible after each set was turned up. Such a test could be used to measure either wet burst strength or wet tensile, but for our purpose we elected to concentrate on the former because of the greater simplicity in manipulation. The first step was the adoption of an accelerated test which consisted of heating the samples in an oven maintained at a temperature of 100°C. for 15 min., and then submerging the samples in water at 25°C. for 2 hr. and determining the burst strength on the unblotted wet sheet. This test gave burst tests which ran consistently 125% of those obtained by conventional test method on aged and conditioned paper. Hence 80% of the actual wet burst as determined by the accelerated test gave a good approximation of the standard value. The performance of this test, however, required 2 hr. and 20 min. and the time involved was too long to render the test results valuable for control of machine operation.

The problems involved in developing a quick control method were twofold: (1) shortening the soaking time and (2) developing a consistent procedure simple enough to be used at the machine tester's station. There were two approaches to this test. The resin could be completely cured by preheat treatment in which case the burst strength would be higher than that obtained by standard procedure and a conversion factor would be required to bring the actual test result down to the standard value. This procedure would cover grades in which the wet strength was derived from the addition of urea-formaldehyde resins where wet strength develops on standing as well as grades in which melamine or quick developing urea resins were used. The alternate procedure was to soak the sheet as it came off the machine without preheating and applying a conversion factor to bring the actual tests up to the standard values. At the outset it was thought that the first approach was better because the burst tests would be higher (and error reduced) and it was probable that only one conversion factor would be required for bleached and unbleached grades, whereas in the second approach a factor would be needed for each grade. In the preliminary experimental work samples of both bleached and unbleached grades were used. Test results were more consistent on the bleached than on the unbleached grades, due as was subsequently determined, to wider variation in sulphate ion content in unbleached when runs were made with melamine as the wet-strength agent. The present control method does detect and permit correction of excess sulphate ion content during a machine run.

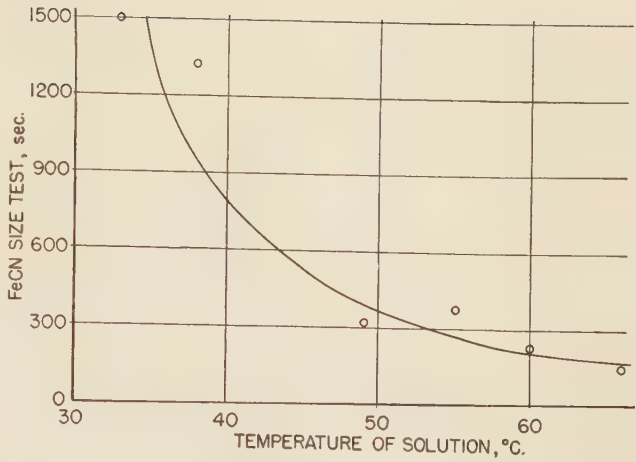


Fig. 1. Effect of temperature on ferrocyanide size test

The second step in development of a quick test was to determine the effect of temperature on the size test of the sheet. To accomplish this the ferrocyanide test was applied through a wide range of temperatures. The effect of temperature on size test is shown in Fig. 1. It will be noted that the size test at 65°C. is only 15% of that at 32°C. Moreover since the ferrocyanide test is one-sided, complete immersion should still further shorten soaking time. This confirmed that soaking at higher temperatures would be very much shorter than at room temperature.

A shortened test was then tried with 15 min. heat treatment at 100°C. followed by soaking at various temperatures, and the results compared with a reference test made in the standard manner. As previously suspected, results obtained at higher soaking temperatures indicated breakdown in the

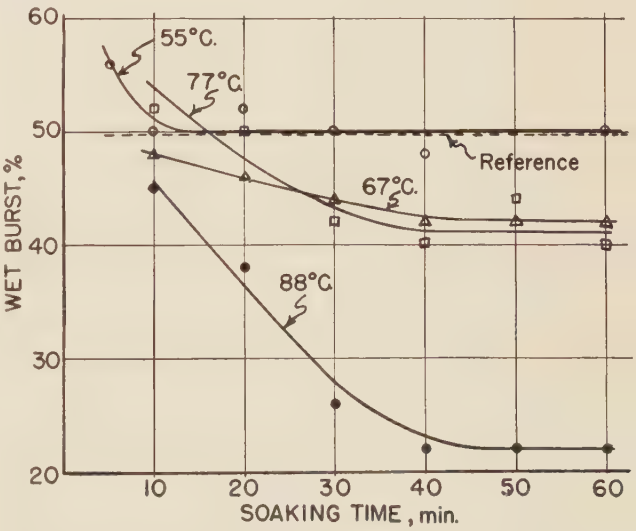


Fig. 2. Effect of soaking time on per cent wet bursting strength at various temperatures

A. G. Durgin and W. G. Baker, Brompton Pulp & Paper Co., Ltd., East Angus, Que.

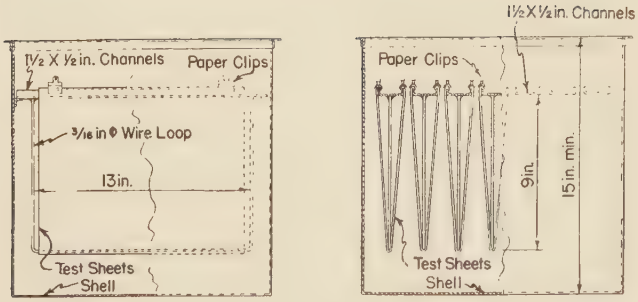


Fig. 3

wet-strength characteristic of the sheet, presumably due to hydrolysis of the resin. This point was then investigated with the results shown in Fig. 2. At temperatures above 55°C., there was distinct evidence of breakdown in wet strength. The high results at the start of the 55° curve indicate incomplete saturation of the sheet during the first 5 min. exposure to soaking. The fact that the curve remains flat during the period of from 10 to 60 min. submergence shows that no appreciable hydrolysis occurs during that period. While a soaking period of 15 min. at 55°C. was apparently adequate to duplicate the standard soak on paper up to 50 lb. basis weight—a factor of safety was deemed advisable and a soaking period of 30 min. and a temperature of 45°C. was adopted as standard. The use of various wetting agents to shorten this soaking period was explored but the end results were both nonuniform and at variance with the results obtained in reference tests. Hence, further work with wetting agents was abandoned. Attempts to reduce the time of heat treatment by employing temperatures in excess of 100°C. were made and abandoned due to hazard of burning the sample.

With melamine or quick curing urea-formaldehydes the preliminary heat treatment may be dispensed with and the test can be completed in 35 min. The application of a conversion factor is required for each grade. This factor was found by comparing quick test results with those obtained in standard method. That is:

$$\frac{\text{Standard test}}{\text{Actual quick test}} = \text{Conversion factor}$$

The conversion factor must be the average of a large number of tests but once it has been established experience has shown that it is stable, and variations in quick test results are traceable to variation in operating practice. The test has now been in regular use for 16 months and its dependability has been proved by regular comparison of results obtained through its use with test results obtained from duplicate samples which have been seasoned at 21°C. and 50% R.H. for at least 10 days and then checked by standard procedure. In experimental work it was clearly shown that to obtain reproducible results during soaking the samples must not stick together nor adhere to the sides of the vessel. To prevent this, a simple soaking tank was designed, not only to avoid this difficulty but also to insure uniformity of temperature during the soaking period. The construction of the tank is shown in Fig. 3. This tank is 15 in. long, 15 in. wide, and 15 in. deep, made of copper and is equipped with thermoregulator, heating element, and thermometer. The copper frames are 12 by 9 in. and stand vertically in the soaking bath being supported by ledges on both sides of the bath.

The procedure, which evolved from this experimental work and which is now in mill use is as follows:

Sampling. Samples of size sufficient to provide four sheets 12 by 18 in. are taken from front, center, and back of each reel and are identified by date and reel number. Basis weight is determined immediately on these samples in conformity with standard mill practice.

One sheet from each basis weight sample is removed for quick wet-strength test and the remaining sheets are forwarded to central laboratory for seasoning and for test under standard method.

The wet-strength sample is clipped to the frame using clips for the purpose, and the sample is submerged in the soaking bath maintained in a temperature of 45 ± 2°C. for a period of 30 min.

At the conclusion of the soaking period, sample is removed from the bath and tested immediately and without blotting, on a standard Mullen tester. A minimum of 10 bursts are taken around the periphery of the sample, five bursts from wire side and five from felt side of each sheet. Average wet bursting strength is determined by averaging these tests.

The result of the test is converted to per cent wet burst by application of the following formula:

$$\% \text{ Wet burst} = \frac{\text{Actual wet burst} \times 100}{\text{Basis weight of dry sample}} \times \text{Conversion factor}$$

As previously stated, a conversion factor is required for each grade. This factor is obtained from application of formula

$$\text{Standard test/Actual quick test}$$

and is the result of a large number of individual tests.

Forty Years Progress in Safety

D. C. EVEREST

"PROGRESS" is a word meaning different things to different people. It is an achievement that can be measured in various ways.

In many fields of endeavor, progress is measured more often than not by increase: increase in efficiency, increase in capacity, increase in production. But in a field such as safety, where the goal is prevention, progress is more accurately measured by decrease: decrease in waste, decrease in suffering and untimely death, decrease in hardship and heartbreak. Significantly, such decreases as these contribute tremendously to those increases which spell progress in other fields. Any seasoned industrialist who has a modest degree of foresightedness will declare, from his own experience, that an effective safety program helps to increase efficiency and production.

Last year, the National Safety Council estimated that organized accident prevention has been responsible for the saving of 500,000 lives since 1913, the year the Council was organized. Five hundred thousand accidental deaths prevented in 40 years! This is the kind of decrease I'm talking about! Decrease that spells progress!

This is an accomplishment that ranks with the discovery of life-saving "wonder drugs" and surgical techniques. All of us are aware of medical science's contributions as well as spectacular progress in other fields; yet, how many of us are as fully aware, and appreciative, of the contributions made by the safety movement toward civilization's advance?

Organized accident prevention has been a mutual effort and it must always be a mutual effort. Every one of us has a big stake in safety for the mere reason that we are human beings; because—to use a line from a piece I shall later quote more extensively—"We are involved in mankind." Like religion and the other more important things of life, accident prevention must stop at no class lines, no industry lines, no boundary lines of any kind. We are all involved, we must all put our shoulders to the wheel.

The pulp and paper industry has always been one of the influential leaders in industrial accident prevention. Representatives of the industry served as founding fathers of the National Safety Council, back in 1912.

I have reread the speech I made at that time and except for

D. C. EVEREST, Chairman of the Board, Marathon Corp., Rothschild, Wis.

changes in the figures relating to accident frequency, severity, benefits, and other statistical information, I might well have used the same speech today. Basically, the need for work in safety and all that goes with it has not changed in the 38 years since this section was formed.

Paper mills were also a prime mover in getting statewide safety organizations underway. For example, the first organized safety conference in the Wisconsin River Valley, held at Wausau in 1927, listed a significant number of paper industry personnel on its program. And through the years, the paper industry has always been a mainspring in organized safety movements in many states. Comparing the attendance of that first meeting referred to with the attendance today is at least one way in which we might use a form of increase to measure safety progress!

The paper industry was one of the pioneers of safety engineering. Accident prevention was purely a spare-time proposition in the mills of earlier days, as it was in all industry. But it didn't take long for men to see that the job of preventing accidents was a full-time one, demanding special skill. Paper mills were among the first to realize that safety was a fundamental part of production, and that from the viewpoint of both humanitarianism and sound business, it was an activity demanding full-time attention.

The same applies to first aid and industrial nursing. Some of the earliest industrial nurses were those who went to work in the paper industry, and the crude first-aid stations that they created were the forerunner of our modern industrial first-aid unit. On-the-job injuries and complaints are only one phase of today's industrial nursing functions; their programs now spread their beneficial influence far beyond the mill gates, into workers' homes.

Paper mills were far different 40 years ago than they are today. And accident records were far different then, too! Machinery was primitive and particularly vicious as far as workers were concerned. Guarding was at first unknown, and the earliest guards were often nothing more than crude rails; mere reminders of danger, rather than barriers to fence off hazards. A far cry from the carefully designed guards of today!

Men often went barefooted in paper mills and other industries. Housekeeping was generally very bad, if existing at all. Morale was probably almost as bad, due to the hazardous and unsanitary surroundings. Needless to say, accidents were far more common and severe in the old days. Compare the paper industry's over-all accident frequency rate of 43.50 in 1923 with that of 10.06 in 1952.

Accident prevention is by no means a simple task in our country. It never was and it never will be. There are an unusually large number and variety of hazards involved in our various operations. It is no easy task to control hazards in logging operations or around machines that turn out paper at speeds in excess of 1000 f.p.m.! We must be tireless and we must be constantly on our toes.

The most direct way to trace safety progress, of course, is through the trend shown by the accident statistics. There are not many available records for the period of 30 to 40 years ago in the paper industry or in most industries. Safety was quite an informal affair then; for the most part, the records were carried around in the minds of those who were directly concerned with the treatment of injuries. Printed records of safety efforts in the paper industry began with the formation of the Pulp and Paper Section in 1915.

By 1920, 19 paper mills had taken the National Safety Council's cue, deciding that scientific methods, in safety as well as in other fields, depend upon accurate statistics. They began an exchange of their accident experience and, by 1924, 62 mills were filing reports with the Council statisticians.

We have succeeded in pulling down our industrial accident frequency rate from 43.50 in 1923 to 10.06 in 1952. Our severity rate parallels this trend, descending from 2.73 in 1923 to 0.98 in 1952. Here is one very tangible evidence of progress... and of long, hard methodical work!

Keep in mind the fact that while this steady safety progress has been made, the industry has gone through tremendous growing pains, increasing sharply its plants, employees, capacity, speed of machinery, output per worker, and number and variety of hazards!

The trend in insurance rates is another way in which we can glimpse progress. Improvement in an industry's accident experience will eventually reveal itself in a reduction of workmen's compensation insurance rates, as the rates are based upon a specific industry's accident experience within a given state. It was reported in a recent issue of the National Safety Council's Pulp and Paper Section newsletter that the Quebec Pulp and Paper Association, in the 19 years since it organized a safety program, has had its compensation rates reduced by an average of $4.79. The association estimates that this is equivalent to a saving of almost 54 million dollars in compensation insurance alone, in spite of the fact that individual allowances to employees increased by 50% because of more generous compensation benefits in recent years.

By showing you the trend in Wisconsin's insurance rates, I will undoubtedly be showing you, too, what has been happening in just about every state where the pulp and paper industry is prominent.

In the classification for paper manufacturing, the workmen's compensation rate in Wisconsin was $2.61 in 1934, and went still higher to $2.72 in 1935. From there the trend has been downward and stands today at $1.34, a decrease of approximately 51%.

In the classification for paper goods manufacturing, the rate went from $1.25 in 1934 to $0.72 in 1953, a decrease of nearly 43%.

For pulp manufacturing by use of chemical processes, the rate declined from $2.55 in 1934 to $1.34 in 1953, approximately a 48 % reduction.

For pulp manufacturing through the groundwood process the rate went from $4.13 in 1934 to $1.34 in 1953, a decrease of about 68%.

By taking these four basic classifications of the industry, we find that in the last 19 years the decrease in insurance rates has amounted to an average of approximately 52 %. In other words, thanks largely to their patient and conscientious efforts to prevent accidents, Wisconsin's pulp and paper industry has done better than cut its workmen's compensation insurance rates in half. The story is no doubt as significant, or more so, in other paper industry states.

Of course it is true that wages and over-all payrolls have increased substantially throughout the same period. At the same time, however, there has been a tremendous increase in workmen's compensation benefits in Wisconsin and other states through the same period. In these same years covered by the rates I have just cited, benefits have been increased 45% in our state. Since the workmen's compensation law was enacted in Wisconsin in 1911, benefits have been increased 171%.

There clearly had to be tremendous improvement in accident prevention, within the pulp and paper industry, to bring about this steady decrease in insurance rates. Here again is very tangible evidence of safety progress!

Individual safety records within the pulp and paper industry are growing more spectacular, as years go by. Not too many years ago,"the safest paper mill in the world" was one which employed 600 and ran 150 days without a disabling injury. Today, consider the no-injury record in our industry of the Dixie Cup Co., with 3,770,076 safe man-hours! Or consider the safest newsprint mill in North America, cited recently by the National Safety Council—the Wayagamack Div. of the Consolidated Paper Corp., Ltd., which ran up 3,900,000 man-hours without a single disabling injury!

These are phenomenal records. They more accurately

show what can be done, rather than what is generally being done. But these records are as inspiring as they are unique. What used to be impossible in the old days is being done today.

Forty years of steady progress in our industry is something to be proud of, but it guarantees nothing for today, if our efforts slacken. We must concentrate on today, and cautiously discount our 40 progressive years of "yesterday." We must never lose sight of the fact that coasting on past performance is always a downhill coast.

Forty years of safety progress, in itself, means nothing as far as today is concerned. It doesn't lessen the mangling power of misused tools, the bone-snapping jolt of a fall, the penetration of a machine's bite into flesh and bone!

No, we cannot forget that accident prevention is like breathing, itself. Just because we've been doing it all these years doesn't mean that we've earned ourselves the right to quit! Safety education and supervision are the necessary oxygen to our operations. Cut off these efforts, even momentarily, and our safety and production records would soon become choked with many kinds of disaster!

We are doing a pretty good job, but much remains to be done. The great majority of management in our industry has long been safety-wise, I believe; but there are still some who need to be enlightened. There are others who need to take more vigorous steps than they have taken thus far. Furthermore, although our pulp and paper section has shown encouraging growth, there are many more companies within our industry that should be affiliated with the National Safety Council.

It has been estimated that the production of the pulp and paper industry will increase between 50 and 60% within the next decade, if we can judge by our past experience. This is both stimulating and a sobering prospect to contemplate. It is sobering in that many of the safety men in our industry are already overtaxed. Accident prevention is a full-time job, and too many are still trying to handle it on a part-time basis. We must see to it that our safety programs expand simultaneously with our production facilities in the years ahead!

I would like to turn, in conclusion, to some words written by an Englishmen over 300 years ago. While I have never seen these words in connection with the safety movement, it strikes me that there is no better creed, no better statement of principle and purpose, than these meaningful lines, written by the British poet and minister, John Donne. The thought behind this expression has haunted and inspired many people down through the years, including one of America's great writers, Ernest Hemingway. Therefore, I hope that their meaning will haunt you and that you will forever apply these noble thoughts to the tremendously important business of preserving human life and happiness and potentiality.

Here, then, is what John Donne had to say about the value of human personality, in one of his poetic sermons . . .

> "No man is an island, entire of itself;
> Every man is a piece of the Continent;
> a part of the main.
> If a clod be washed away by the sea,
> Europe is the less,
> As well as if a promontory were,
> As well if a manor of thy friend's, or of
> thine own were.
> Any man's death diminishes me, because
> I am involved in Mankind.
> And therefore, never send to know for
> whom the bell tolls;
> It tolls for thee . . ."

If you remember nothing else, please remember the meaning of these words. Please remember when a logger, or a paper mill worker, or any man, needlessly dies, be it in Oregon, Maine, or anywhere on this globe of ours, his death diminishes you and me, because we are "involved in mankind."

And just as "No man is an island, entire of itself," so no single industrial organization is an isolated island of self-benefit. Every paper mill, every factory, every individual enterprise is "a part of the main." So whatever you are doing to prevent accidents is benefiting, not just yourself, not just your industry, not just your community, it is benefiting mankind.

The men who have devoted their lives to accident prevention know full well "for whom the bell tolls," and their great and eternal objective is to silence its tragic knell, by stamping out needless suffering, and hardship, and death, in our society.

Presented at the 1953 meeting of the National Safety Council.

What a Superintendent Expects of a Safety Program

DONALD O. COLLINS

THE superintendent, along with other members of the management team, has a definite moral responsibility for the safety of the men working under his supervision. His is the responsibility of reducing to a minimum, if not entirely, the mill accidents which are the cause of so much human suffering, to more people than just the injured person.

In addition to the responsibility for employee safety, the superintendent is also charged with getting out maximum production of high quality products at a minimum cost, utilizing both manpower and machinery to the best advantage. The loss of man-hours through accidents increases operating costs. Then, too, as a result of accidents, there are the losses due to a decrease in production, the cost of training substitutes, and other factors which all add to over-all production costs.

Any program or plan which will reduce costs and encourage better and more efficient production is certainly one which will be welcomed and adopted by the superintendent. He expects the safety program to accomplish this. When I say safety program, I don't mean the safety department, or the safety director or safety supervisor. I mean the whole, over-all safety program.

From the foregoing remarks you might be led to assume that the superintendent expects a great deal from the safety program and he does.

First of all, we should consider the importance of having a well-rounded and sound safety program, instituted, supported, and sustained by top management. This should be a program of well-defined purpose, with sufficient responsibility and authority delegated to the safety director for the purpose of seeing that its objectives are furthered to the fullest possible extent. It should be a program that approaches each problem in a positive way.

Having attained this type of overall program, it is reasonable to assume that it will be possible to get the cooperation of all members of the organization for carrying out successfully the program's objectives.

The superintendent expects quite a lot of help from various people and departments. He needs this help if he is to do the kind of job he wants to do, and is expected to do.

Some of the many ways in which the program can help him do a better job, not from just the safety standpoint alone, but from a production standpoint as well, are:

1. Encourage use of better placement procedures.
2. Help to develop better methods for training employees.
3. Provide proper supervisory training to enable them to do a better and more thorough job of training employees.
4. Encourage the use of job analysis or job breakdown.
5. Establish and maintain a program of good will housekeeping.
6. Encourage employee suggestions.
7. Publicize good safety records of individuals and departments at least as much as lost time accidents.

DONALD O. COLLINS, Assistant Superintendent, No. 1 Paper Mill, The Mead Corp., Chillicothe, Ohio.

8. Maintain, analyze, and make recommendations concerning major and minor injury reports to prevent recurrence of injuries.

First is encouraging the use of better placement procedures to insure getting as nearly as possible the right person on the job for which he is best fitted. This requires a great amount of skill and knowledge on the part of the employment manager or the interviewer. He must determine the basic abilities and aptitudes of the potential employee, as well as his personality traits and attitudes before trying to make a decision as to where the person may be used to the best advantage. It is important that a proper decision be made at this point. The new employee starting on his first job with the organization is anxious to make good. Sometimes the new man, in a desire to prove that he can do the job satisfactorily, tries to do more than he is capable of doing which frequently results in an injury or illness.

The safety program could help to develop better methods for training employees. The new employee coming on the job and the older employees advancing to unfamiliar jobs require sufficient training to acquaint them with good safety methods as well as efficient production methods. Good safety methods and good production methods go hand in hand.

The job of training or teaching should naturally be the responsibility of the departmental foreman. To him goes the opportunity of leading his crews to production and safety records. However, he would appreciate any additional help which might be available through the safety program in aiding him to set up better training methods.

The safety program could help to provide proper supervisory training to enable him to do a better and more thorough job of training employees. A great deal has already been done in this field, but there is still much to be done in developing a comprehensive and acceptable training program which can be incorporated into the daily production schedule of the line foreman. A program of this type is needed in all industries where expansion in the last few years has been very rapid with the consequent influx of many new employees and the advancement of older employees to higher skilled jobs.

The safety program could encourage the plant-wide use of job analysis or job breakdown. By properly breaking the job down to its basic and essential steps, then listing the steps in proper sequence, both the employee and the supervisor have a clear understanding as to what is to be done and how it is to be done. When the job is clearly understood by both the foreman and the worker, they are then able to go ahead, each with the assurance gained by a mutual understanding as to what is required to get the job done safely and efficiently.

The need for the understanding gained by job breakdown or analysis generally shows up in the accident investigation. From two injuries which occurred in our machine room the past year, you may draw your own conclusions.

A third hand on a paper machine which we will call machine A had been an employee for seven years, five months, and on his regular third-hand job for $2^1/_2$ years. Due to the illness of a machine tender on machine B, the backtender was moved up to machine tender and the third hand on machine A was transferred to backtender on machine B. The backtending job was not new to him since he had previous experience on his regular machine which is right-hand operation. However, machine B to which he was transferred is left-hand operation. According to the accident report, the employee was washing the felt on the first press. When pulling the felt back out after having roped it up, his left arm was pulled between the felt and the felt roll. Results—injured arm and shoulder—has lost several months work and is still losing time.

Another employee at the time of his injury had been with the company 6 years, 10 months, and on his regular third-hand job for 1 year and 10 months. Due to the vacation schedule he was moved up to backtender. The accident happened as follows: the front (or north) reel had been filled and the backtender had just turned the paper over on the new (south) reel. (This changing up of reels is done with an air hose.) He still had the air hose in his right hand and when he turned from south to north, the tip of the air hose was caught between the full reel and the reel drum. (The full reel had been raised just enough to take the weight off the drum.) The injured man's hand was pulled in between the reel and the drum. Result—severe injuries to right hand and forearm.

You will notice in each of these two cases that the injured men had one thing in common. Each at the time of his accident was working on a job other than his regular job. We might upon closer investigation discover that they had other things in common, such as: both men had some previous experience on the higher skilled job; they were considered safe workers at all times; and handled their jobs capably and efficiently. They were the kind of men necessary to make up a good machine crew.

However, these are just two of several similar accidents experienced in our plant in the last year, most of them involving people who were transferred or promoted to higher skilled jobs. Where are we failing these people? How can we help them and ourselves? Possibly through the use of job analysis or job breakdown.

The safety program could help to establish and maintain a program of good mill housekeeping. This can provide many benefits both to management and employee. A plant or department that is clean and well organized tends to make the employee proud of his work place and his department. With just a little encouragement, he will try to keep it in first-class condition. As everyone knows, a clean department is nearly always a safe department due to the fact that it is free from the dirt, grime, unused equipment, and accumulated trash which make common accident hazards.

A good program of cleaning up and painting is a tremendous morale booster for the employee because he feels that management is interested in his welfare.

In our mill we have a complete mill inspection once each week. The inspection committee is composed of mill manager, safety superintendent, and two operations supervisors. Two new operations supervisors are put on the committee each week, replacing the ones who served the preceding week, so that eventually every supervisor in the mill will have had a chance to tour the whole plant.

The purpose of this committee is to search out and report back to each department head all of the safety hazards and poor housekeeping practices observed during the inspection. It's really surprising what someone outside of your own department can find wrong with your department. Especially conditions that you should have been aware of long before the committee arrived. However, it is a wonderful program and has been particularly successful in our mill due to the keen interest and helpfulness of our mill manager.

Since this program has been in effect in our mill, our foreman and employees have taken a much greater interest in good housekeeping practices than ever before, and the results are extremely gratifying. It shows that the man on the job can and will take an interest, if the boss is interested. In connection with this weekly mill inspection, our departmental supervisors are having an opportunity to see the whole mill and are gaining an appreciation of some of the problems existing in departments other than their own.

A safety program could encourage employee suggestions. One good source of obtaining safety suggestions as well as suggestions for more efficient production methods, is from the workman himself. He is the man who, if properly encouraged, can be of the most help in pointing the way to easier methods, more profitable methods, and safer methods. His suggestion occasionally may need some study and additional dressing up to make it workable. That, however, is a chal-

lenge to supervision. It is also a responsibility of supervision.

Too often the employees' suggestions are bottled up, forgotten, or ignored, or, worse still, appropriated by someone else; sometimes, by the very one to whom the suggestions are made.

This is one of the greatest detriments to a good safety program because it discourages good suggestions and has a tendency to make the man on the job indifferent and sometimes antagonistic toward the whole safety program.

To encourage employees to turn in suggestions, it would seem advisable to set up some system whereby their suggestions could be recognized. This could be done by publicly acknowledging all good suggestions. In addition to this, a letter of commendation could be sent to the employee's home.

In cases where a suggestion was not considered to be of sufficient merit to be accepted, the employee should be contacted personally by the safety supervisor and it could be tactfully explained why his suggestion could not be used.

Whenever a man makes a suggestion, he considers it to be good regardless of whether it is or not. If the person who receives the suggestion thinks it is no good, or doesn't take the time to evaluate it, and allows the suggestion to die on the vine, we not only lose the suggestion but we lose, possibly forever, any interest that could be had from the employee, if only his suggestion has been acknowledged.

On the other hand, it is really surprising how many good suggestions will be turned in when the fact becomes known that something is going to be done about them.

A safety program could publicize good safety records of individuals and departments at least as much as the lost-time accidents and poor department records.

All of us here realize that nobody likes to be on a losing team. More and better use of the positive approach to accident prevention should result in improved employee morale and create a greater desire on the part of the employee for some of the so-called "hazardous" jobs.

Proper publicity through plant magazines and local newspapers, as well as departmental bulletin boards, could do much to offset the bad publicity caused by lost-time accidents.

When I was young, I thought that one of the worst possible places in which a fellow could work would be in a paper mill. Why? Because the only news items concerning our local mills were always something like these: "Local mill employee suffers loss of right eye"; "Paper mill worker loses right arm in accident on winder"; "Cutter operator loses hand"; "Machine room employee killed."

A little good publicity concerning safe practices and good safety records would have given me a little better opinion of work in a paper mill.

A safety program could maintain, analyze, and make recommendations concerning major and minor injury reports to prevent recurrence of injuries.

Here is a fertile field in which we can all work. It is very often possible, through the proper interpretation of injury patterns, to determine if an unsafe condition exists on a specific job. This study may also indicate that unsafe practices are being engaged in.

Situations can only be analyzed properly if accurate and up-to-date records are maintained. It is in this field that the safety supervisor, the plant physician and nurse and the personnel department can be of great help. The accurate and prompt relaying of information of this type will go a long way in helping supervision in the operating departments to set up a good accident prevention program for each department.

We could go on listing the people upon whom we depend in helping to make a good safety program; and the kind the superintendent expects and needs to help him do his job properly.

The eight points we have considered are just a few of the things which a superintendent expects of a safety program. Safety and production go hand in hand, and anything which improves safety is bound to be reflected in lower production costs.

Practically all of the points covered deal with some form of instruction or education. What better method of accident prevention can there be, than education?

Presented at the 1953 meeting of the National Safety Council.

What a Foreman Expects of a Safety Program

EARL D. HARGIS

I WAS a country boy who knew enough to stay out of reach of a mule's hind legs, but that pretty nearly was the extent of my safety consciousness. In 1923 I went to work in the pulp and paper industry with the Bastrop Pulp & Paper Co., one of the pioneer paper mills in the South and now acquired by the International Paper Co.

After a time, safety started to make its way. At first, it was slow and progress was made in faltering steps. Later, however, the safety program really began to gain momentum. A full-time safety director was placed in charge of safety, and the safety program with which I am acquainted came into existence. After a short period of aches and pains, it finally got rolling. Foremen and men alike became interested. They began to realize what safety really meant. Not only to the men individually, but to the group as a whole and to production. A better relationship and understanding between supervisors and men developed from safety talks about what could and should be done in the department for the welfare and safety of the employees.

We also realized that top management was vitally interested in safety and demanded of the foreman not only production and quality, but production and quality with safety. The foreman now knows that he is not only responsible for good production, but for a good safety record, good housekeeping, and all of the many different matters he must watch over to maintain a well-run department. However, he expects, after being told that safety is equal to production and quality, to have the complete backing of top management in carrying out the safety program.

A foreman cannot carry out a single-handed safety program. He can instill in his men the necessity of safe thinking, and train and teach them the methods of safe performance of their duties, but that is not all there is to a safety program. We believe that many people fail to realize what the word program really means. To many people, it only means, when used in safety work, a certain number of meetings, display of posters, stunts, and other activities to stimulate interest in safety; but it also means planning all work in the department with safety in mind.

Today, the foreman takes pride in his department and desires to continually improve its safety record. In carrying this out, he expects assistance and cooperation not only from the safety department but from other departments, supervision, and top management, as well.

He knows that he is responsible for the production within his department, but if either the inlet or outlet or materials fails, his production stops. Thus, he must depend on other departments for assistance in maintaining full production within his own department. If the equipment breaks down, aid from other departments is also necessary. And so it is with safety. If outside assistance and cooperation are not given, the safety program collapses.

A safety program is not departmental, but plant-wide. What a foreman expects of the safety program can follow the same lines as followed in production. If in any part of his de-

EARL D. HARGIS, Pulp Mill Tour Foreman, International Paper Co., Bastrop, La.

partment, an unsafe condition exists which he himself cannot correct, he will report it to the proper departments and will expect the same service that he would receive if the problem were directly connected with production.

But there have been times when foremen have reported an unsafe condition and requested that it be corrected, but have waited and waited before the situation was corrected. When this happens, the safety program receives a very bad setback.

Safety men can realize what position a foreman finds himself in, if he has talked and talked safety to his men and then when an unsafe condition has been reported to him nothing is done to correct it. Sooner or later, all safety talks fall on deaf ears. All posters, safety articles in plant papers, safety meetings, and other stunts connected with safety become mere empty gestures.

I know of a case where a step on a stairway had been broken and was a very dangerous hazard for a long time. It had been reported time and time again. One day a very good operator took a fall on this broken step. He suffered a fractured hip and it was months before he was able to return to work, and he was never the same again. Some said he should have looked where he stepped. They were wrong. They merely alibied for their failure to do the repair work when requested. Yes, the steps were fixed—*after* the fall. Is this the kind of cooperation a foreman should expect from a plant safety program?

Not only when it comes to repairs do we expect cooperation and assistance. The same holds true when changes in equipment and machinery are made in our departments. Sometimes we know about the changes being made, but when the safety factor is involved, most of us are never consulted. I have known of installations being made, which undoubtedly looked fine on the drawing board, but when installed they were found in an inaccessible location, creating a hazard for the operator, or they had been made in poorly lighted places. These things always handicap a safety program. A foreman expects from the engineering department the same service that he expects from other departments when it comes to safety.

I have talked a great deal about the cooperation a foreman expects from others in the plant-wide safety program. I have not mentioned the safety director. Of him we expect everything we expect of everyone else, and then some. I have heard the statement that the foreman is the key man in a safety program. This may be so, but who is the key? I would say the safety director, engineer, or supervisor—whatever his title may be.

A foreman does not expect the safety director to run the safety end in his department, but he does expect from him all the advice, information, facts, and figures pertaining to safety.

He expects from the safety director information regarding all new developments in safety protective devices and how to eliminate unsafe practices.

He expects, on many occasions, for the safety director to act as a liaison man between him and other departments and sometimes to top management.

He wants him to hold informal meetings with him and his men to stimulate interest in safety.

He also depends on the safety department for help in providing the necessary push to put over new ideas.

The foreman wants to be sure that the safety department advises him of all unsafe practices and conditions in his department which might arise from the installation of new equipment or changes in working conditions, or any other unsafe conditions which he might have overlooked.

When a safety inspection or a personal injury investigation is made in his department he wants to be a part of it and to be advised what recommendations have been made.

The foreman does not expect the safety director to fight his battles for him, but he does expect his help and support. He expects from him the same cooperation he expects from a technician or engineer, when a problem in safety confronts him which is beyond his knowledge or experience.

He wants to know what other departments in the mill are doing in safety and what departments like his in other mills are doing. In short, he wants to be kept well informed.

The foreman wants to know, when a new employee comes to his department that he is physically fit to do the work to which he will be assigned; that he has been thoroughly and effectively instructed by the employment office on company policy regarding safety, first aid treatments, and hazards on the job.

A foreman can expect many things of a safety program, but in this, as in many other things, he cannot expect any more out of the safety program than what he puts into it.

I can assure you that if every foreman can get what he expects out of a safety program or safety procedure, which is the same cooperation, assistance, and help he receives in connection with production and quality, then he will gladly do his part in order to see a happy, cooperative, efficient, and accident-free department, not only his own, but all through the plant.

If this can be achieved, the foreman can have a shop or plant to which safety men can point with pride and say, "My plant has an outstanding record in safety."

Presented at the 1953 meeting of the National Safety Council.

What an Hourly Worker Expects of a Safety Program

ELMER COLLAR

As AN hourly paid worker, I think I can give many good reasons and ideas on what an hourly paid worker expects of a safety program. I have worked for Kimberly-Clark for better than 12 years and during that time I have always taken a leading part in safety promotion.

For the first 7 years of employment I worked in a finishing department, and was safety chairman of the department. Later I became safety chairman for the Badger Globe Div. of Kimberly-Clark and was chosen to represent the hourly worker at the National Safety Congress that year. Upon being transferred to the Engineering Department at Lakeview mill, the employees again elected me as the chairman. After taking a leading part in safety for these many years, I feel that I really can say what an hourly paid worker expects of safety promotion and safety ideas.

Let's start out first of all by saying we have just hired a new man. We take this man through the plant and show him the different operations and the way our older employees work. The first impression should be a good one, so let's make the safety impression the best we possibly can.

After the employee works for awhile it is time to talk over the safety program with him, get his ideas and, if he is the kind that has some good suggestions and ideas, give the fellow a chance sometime to play a leading part. It's always good to let a working man get up at a safety meeting and talk to the group. I am sure that there are a number of fellows that will do this if they are given the opportunity. For the hourly paid worker to talk once in a while, gives his fellow workers a better understanding that safety promotion must come from the hourly paid group more so than from supervision. The point to remember is not to let supervision do all the talking and promoting; work together as a unit and you will have a good sound safety program.

Safety equipment such as hard hats, goggles, safety shoes, shields, etc., must be worn when and where needed. I think that nearly every employee will realize that he must wear

ELMER COLLAR, hourly worker, Engineering Dept., Neenah Mill, Kimberly-Clark Corp., Neenah, Wis.

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safety equipment when needed, but do not try to force it down his throat with a "must." Explaining why and when he needs to wear them and letting him have a say in the wearing of the equipment, always creates a better feeling. I know from past experience, that you are going to run into some fellow, once in awhile, who is the "balky" type. He won't wear this or that, because it bothers him, or, he might just be plain stubborn. Here again through a group that works together you will get him straightened out.

At the place where I work, we have up-to-date safety equipment and the fellows do a good job of wearing it at all times. We have a very nice first aid room and the workers expect good first aid and get it. Any sort of an injury is reported to the nurse and the fellows respond very well and we have very little trouble.

We have contests and encourage group meetings, but again I say don't overdo because a record played too often is bound to wear out and so it goes with safety. Get ideas from the group and make changes in the program or contests or whatever you may be doing. This will stir up more interest and enthusiasm and again your goal of working safe will be reached.

The worker expects supervision to be honest and sincere about safety. Too many times a lot of promises and false settlements lead to the downfall of a good safety program. The foreman and higher supervisors must be fair and I am sure that the worker will cooperate.

The question might arise as to what to do about a worker who doesn't obey the safety rules and will not do anything about it. The only thing to do in this case is to get rid of him, simply because he is a hazard to the group, and might also go so far as to ruin the aim of all the fellows he works with. This may be a case where management and hourly paid workers will have to sit down and confer to see what must be done.

We must work together on this very important subject of our life, safety. In order for us to have a good safe place to work we must all pitch in together and by so doing we will find that our work and all the things we do throughout the day will be a greater success.

Presented at the 1953 meeting of the National Safety Council.

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Calendar of TAPPI Meetings

NATIONAL MEETINGS

Corrugated Containers Conference, DeSoto Hotel, Savannah, Ga. (Date to be announced).

Third Statistics Conference, University of Maine, Orono, Me., July 12–24, 1954.

Fundamental Research Conference on the Fundamentals of the Paper Machine, Appleton, Wis., September 21–24, 1954.

Alkaline Pulping Conference, Dinkler-Tutwiler Hotel, Birmingham, Ala., October 6–8, 1954.

Ninth Engineering Conference. Benjamin Franklin Hotel, Philadelphia, Pa., October 18–21, 1954.

Fibrous Agricultural Residues Conference, Northern Regional Research Laboratory, Peoria, Ill., November 8–9, 1954.

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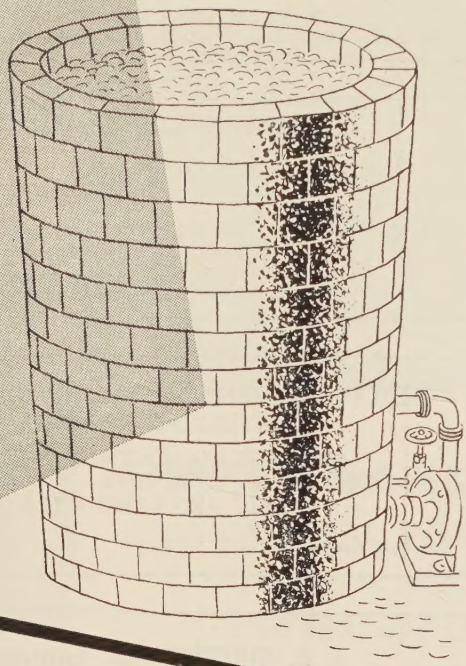

N Silicate works efficiently

In your peroxide system, consistently uniform quality "N" saves peroxide by maintaining even release of oxygen to produce constant bleaching power. N Silicate acts as a buffer to maintain the pH in the bleach bath.

N Silicate is conveniently available

Nine PQ manufacturing works are located in: Anderson, Ind.; Baltimore, Md.; Buffalo, N.Y.; Chester, Pa.; Jeffersonville, Ind.; Kansas City, Kansas; Rahway, N.J.; St. Louis, Mo.; Utica, Ill. N silicate is shipped in tank cars or 55 gallon metal drums.

call PQ® for silicate service.

FREE publications of interest to the paper industry:

- "Silicate of Soda in Paper Making"... Bulletin No. 6-1
- "Sorption of Sodium Silicate and Silica Sols by Cellulose Fibres"... No. 17-27
- "Coating Paper with PQ Sodium Silicate"... Bulletin No. 15-1
- "Treatment of Raw and Waste Waters with PQ Silicates"... Bulletin No. 52-19
- "Stixso Adhesive Processes for Quality Corrugated Paper Board"... Bulletin No. 12-21

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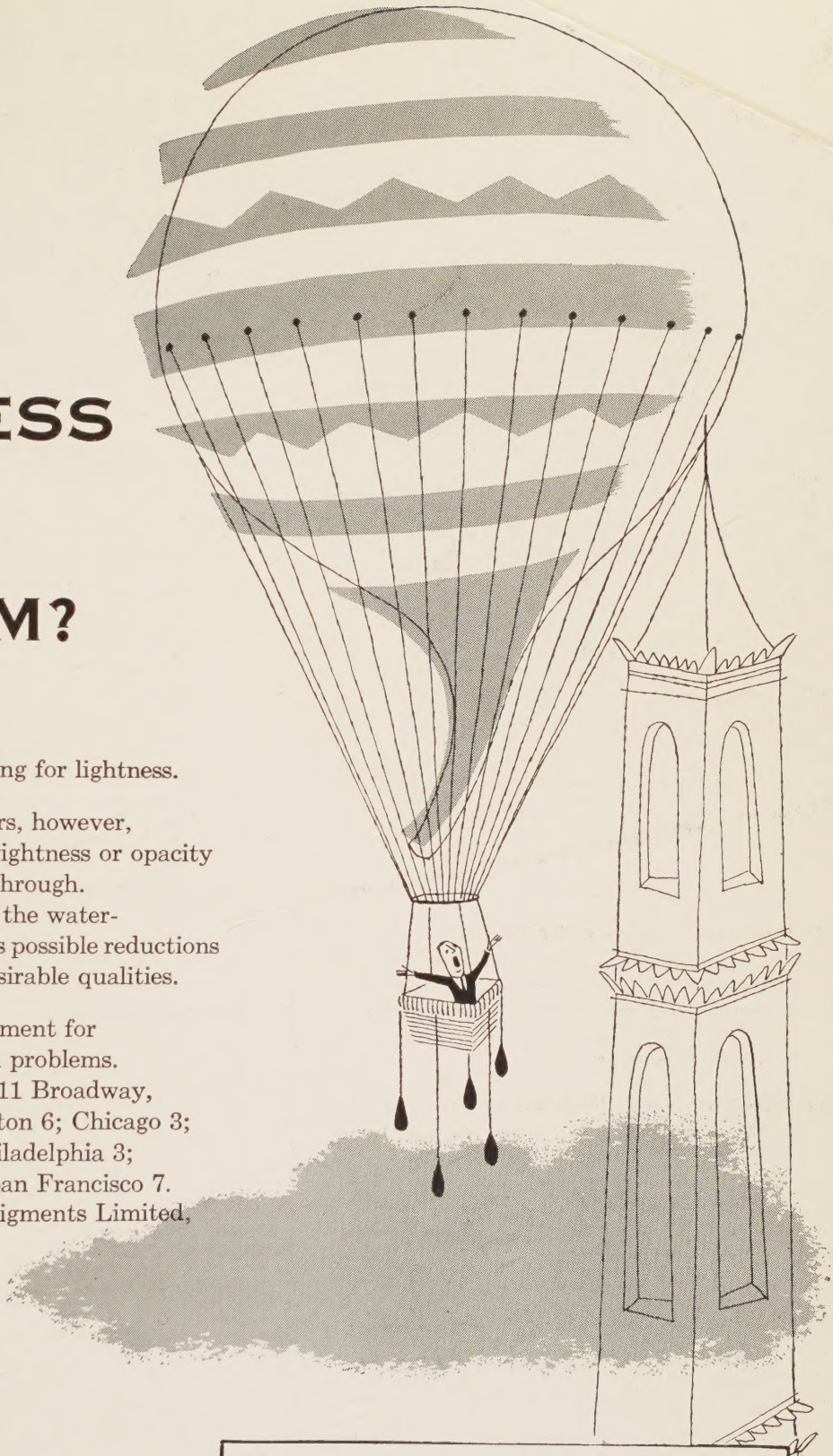
LIGHTNESS YOUR PROBLEM?



In this spot you'd sacrifice anything for lightness.

Reducing weight in printing papers, however, can be done without sacrificing brightness or opacity and without an increase in show-through. Pigmentation with TITANOX-AWD, the water-dispersible titanium dioxide, makes possible reductions in weight while retaining these desirable qualities.

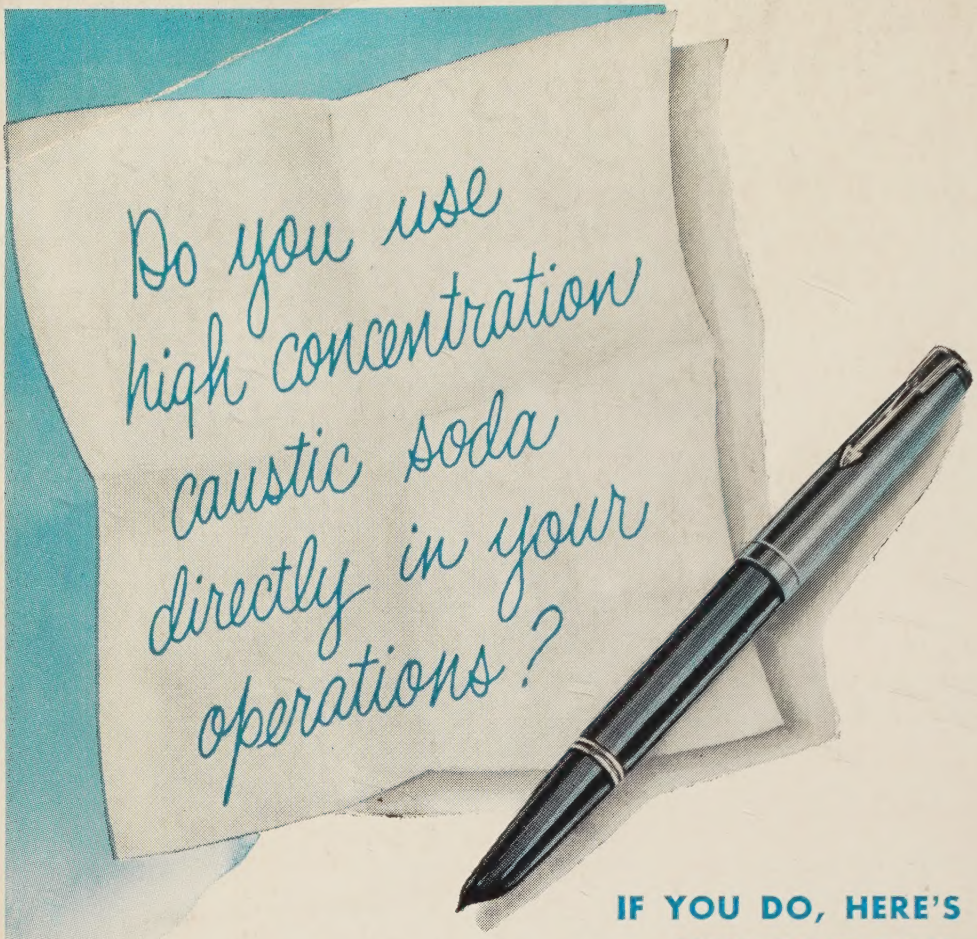
Ask our Technical Service Department for assistance with your pigmentation problems. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y.; Atlanta; Boston 6; Chicago 3; Cleveland 15; Los Angeles 22; Philadelphia 3; Pittsburgh 12; Portland 9, Ore.; San Francisco 7. In Canada: Canadian Titanium Pigments Limited, Montreal 2; Toronto 1.

® TITANOX

the brightest name in pigments

TITANIUM PIGMENT CORPORATION

Subsidiary of NATIONAL LEAD COMPANY



IF YOU DO, HERE'S A THOUGHT THAT MAY SAVE YOU MANY DOLLARS!

Some users of caustic soda who require the high concentration are accustomed to buying 50% NaOH liquor and then adding dry caustic to bring it up to needed strength.

Several of our customers have recently changed to buying the 73% concentration. They store and use it at full 73% strength. All have reported substantial savings on reduced volume cost and reduced man-hours.

If you are not specifying 73%, we believe it will pay you handsome dividends to investigate it.

Our technical staff will be happy to estimate the savings possible on any volume you may select. Just jot down in the block below a tonnage figure. Our engineers will figure out for you the cost of 73% liquor, vs. the cost of 50% liquor with the addition of dry caustic to bring it up to similar concentration.

COLUMBIA-SOUTHERN CHEMICAL CORPORATION
SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER · PITTSBURGH 22 · PENNSYLVANIA

DO IT NOW

Columbia-Southern Chemical Corporation
One Gateway Center, Pittsburgh 22, Pa.

Gentlemen: For comparative purposes only, please estimate for me the cost equivalents of_____tons of 73% caustic soda.

Name_____

Firm_____

Street_____

City_____ State_____